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ELECTRICAL WORLD AND ENGINEER.

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NEW YORK, SATURDAY, OCTOBER 24, 1903.

CONTENTS.

Editorial 665
Annual Report of the Western Union System 668
Enormous Expenditures for Chicago Traction 668
Transmission of Hudson River Power—I 669
On the Mechanism of Electric Power Transmission. By Dr. A. E. Kennelly 673
Grouping of Cells to Obtain Maximum Current. By W. J. Humphreys 674
The Stone Wireless Telegraph System. By Dr. Louis Duncan 675
Alternating Current Switchboards—V. By Stephen Q. Hayes (concluded) 677
Measurements of Radio-activity 678
Photometric Tests of the Nernst Lamp 678
New York Meeting of the American Institute of Mining Engineers 680
The Electric Tramways of Kalgoorlie, Western Australia 682
Methods and Means of Extending New Central Station Business 683
Recent Electrochemical Developments 684
Meeting of the Ohio Electric Light Association 686
Current News and Notes 690
LETTER TO THE EDITORS:
Tests of Tangential Water Wheels. By H. Homberger 691
Digest of Current Electrical Literature 692
New Books 696
Village Telephone Exchange Switchboard 696
Exhibits at Ohio Electric Light Convention 697
Hoisting and Transferring Machinery 697
DEPARTMENTS:
Financial Intelligence 698
Commercial Intelligence 699
General News 701
Trade Notes 705
Record of Electrical Patents 706

OHIO ELECTRIC LIGHT ASSOCIATION.

The meeting at Columbus last week of the Ohio Electric Light Association demonstrated again the great value which, under proper management, such territorial associations may have, not only for their members but for the electric lighting industry at large. At Columbus the majority of the papers and all of the discussions related to the electric lighting situation as it exists in the territory covered by the association, and thus the proceedings have a most direct value to all members, which can rarely be true in the case of the programme of bodies covering the entire country. The programme of papers was of excellent quality, as will be seen from the abstracts which we print elsewhere, and the discussions were kept well to the point, if exception be made of an exhibition of commercial rivalry which consumed a good part of the time of one of the sessions. The practical character of the proceedings is indicated by the fact that half of the papers and topical discussions dealt with the steam end of the central station plant. Perhaps the most notable feature of the meeting was the evident uncertainty manifested as to the relative value of direct and alternating currents for central station service. It is true that none of the old-time animadversions were made against the alternating current; but it was evident that the direct current was yet dear to the hearts of many of the central station men. A reading of the papers and discussions, however, brings out very clearly that the favor in which the latter continues to be held is owing entirely to two factors—the storage battery and the lack of an all-around alternating-current elevator motor. If it can be demonstrated that a rotary converter link between the alternating-current generator and the storage battery does not involve any uncertainty of operation, and if a satisfactory alternating-current elevator motor system is devised, the direct vs. alternating-current question in its present form would no longer harry the minds of central station men and load down the programmes of electric light meetings.

Though the gas engine is used more largely in Ohio than in most States of the Union, it was received with little favor by the speakers who touched upon its use for central station purposes. Here again it would appear that the objections were not to the gas engine *per se*, but to specific machines in the knowledge of the critics, which had not operated satisfactorily. Practical men are prone to make sweeping criticisms based only on their individual experience, which experience may be far from sufficient to justify a general indictment; and presiding officers at meetings such as that at Columbus would perform a particular service if in such cases they were to draw out the specific experience on which a criticism was based or a statement of the conditions thought to sufficiently justify it. The importance of the gas engine situation in view of recent developments is such that it merits the most careful attention of central men, who should not be misled by sweeping condemnations based perhaps upon limited experience or with what in a few years may be obsolete types. As was natural, considerable interest was shown in the subject of the steam turbine, and in the discussion it was brought out that at present direct-current turbo-generators are limited to a capacity of 500 kw owing to the commutator, which even in the size mentioned assumes ungainly dimensions as compared with the other parts of the unit. At this meeting also the first public announcement was made of a new type of arc lamp being developed at Schenectady, concerning which there have been rumors afloat during the past

year or more. It appears that in this lamp one electrode is of copper, and the other is composed of a metallic substance described as magnetite. It was stated that this lamp will give at 300 watts the same quantity of light as the ordinary carbon arc at 450 watts, and the same statement was made with respect to the Bremer arc lamp employing composite electrodes. With two such promising inventions in process of development, the future of the arc light is considerably brightened.

HARNESSING THE HUDSON.

The great Spier Falls power development described elsewhere in our columns is a fine example of the modern idea in power transmission. The stimulus of dear fuel has produced a remarkable revolution in the industry, and the public has come to realize that a great hydraulic power is a very stable and valuable asset when it is within electrical reach of a market. With this very consciousness has come willingness to consider such a plant a conservative and permanent investment, and to establish it on a sound and economical basis. The power at Spier Falls has been known of course for many years, and as in many other cases, has waited in vain for industries commensurate with its importance to gather around it. But other influences than cheap power alone act in determining the location of industrial centers, and it is only since the success of electric power transmission that cheap power and other manufacturing advantages can be made coincident. It is particularly interesting to note that the demand for power from the Spier Falls plant has been so keen that it has become necessary to put into action at once 6,500 kw in generators working in a temporary wooden power house and at partial head on the wheels to save the time which will be required for the completion of the permanent works. There could be no better augury of financial success. The distribution from the finished plant, as will be seen from the general location, will be not a single line to a single market, but a radiating system of lines delivering large "blocks" of power in half-a-dozen different places.

The transmission lines have some interest to the engineer as an expression of sound conservative opinion on line construction. They are all of hard-drawn copper varying in size from No. 000 to No. 0, carried on porcelain insulators. These insulators are of rather moderate size and have to withstand a puncturing test of 80,000 volts for five minutes, and that after the insulator has been soaked 24 hours in water. There is, therefore, a nominal factor of safety of 2.66 in insulation strength. The pole line itself is mainly of 35-ft. poles, 24 in. in circumference at the tops and set 5½ ft. deep. The cross arms are extra heavy, bolted and braced on the poles, and the wires in the three-phase transmission circuit are spaced three feet apart. The poles are spaced down to 100 ft. and even closer on curves, and the whole construction is of the most substantial character. Just at the present time when all sorts of innovations in pole line practice are being tried, it is instructive to see this large installation, supplying vital power for a group of large enterprises, constructed along methods so conservative. There is no doubt that in dealing with insulation for very high voltages such as will be largely used in the future, some new ideas will find place, but is still far too early to speak with confidence of the innovations which have so far been tried. Long spans and insulators the size of wash tubs may be standard practice ten years from now, but it is a good thing to remember that they are now on trial, and that it takes more than one season to try out anything connected with transmission work, assuming it to have any elements of success.

One of the most significant things about the Hudson River system is the nature of the load which is to be carried. The day has gone by in which a water power is developed, distribution rights obtained in the market, and the product peddled out to small consumers. The towns and cities which generally must serve as the market are usually well supplied with electric distribution systems, and the modern transmission project must do a wholesale as well as a retail business, dealing directly with a few large customers, some of them retailers of power and light. In the case before us the energy all goes to a relatively small number of patrons, some of them direct users like the General Electric Company and the Schenectady Street Railway, others distributors like the lighting companies in Troy and Albany. As electrical transmission lines get longer and cover more and more territory, it becomes progressively more difficult for one company to look after the full details of the transmission and to attend to the numberless small distributing systems requisite to supply the territory. These can best be handled by local interests buying their energy at wholesale rates of the great producers. Working in this way it is sometimes possible to sell the whole product of a large hydraulic development as yet uncompleted for future delivery to a single customer on a long-time contract. This is often very advantageous to both parties, since the generating company can reckon at once upon a good and safe return upon its investment, and the distributing company can obtain its stock cheaper than it can manufacture it. It is a natural change in business methods brought about by the growth in the electrical distribution business, and we think that more and more in the future long and important transmissions will be undertaken upon this basis. The East, save in a few localities, has been backward in the utilization of the larger water powers, and we trust that the example set in the great plant before us will be followed elsewhere.

WIRELESS TELEGRAPHY.

The wireless telegraph has for a year or more entered into strong competition with the storage battery as a source of inventive inspiration, as indicated by the record of the United States Patent Office. Almost every week one or more patents on this subject are issued, usually on details, but sufficiently often on systems to make already a formidable list of the latter. During the past year one of the most prolific of inventors in this line as gauged by the number of patents granted in his name, has been Mr. John Stone Stone, of Boston, and elsewhere we print an account from the pen of Dr. Louis Duncan of the fundemental principles of the Stone wireless telegraph system. As will be seen, the main feature of Mr. Stone's system is a sifting device between the Hertzian wave generator and the transmitting antennæ on the one hand, and between the receiving antennæ and the receiving circuit on the other hand, whereby all waves generated except those of a desired frequency are suppressed at the sending station, and at the receiving station only waves of a desired frequency are permitted to pass to the receiver. In this latter respect there is a strong likeness in principle to the Pupin multiplex telegraph system, in which tuned circuits are employed in a similar manner to the end that a multifrequency current charged with a number of messages may be enabled to deliver each message at the station tuned to the frequency at which it was transmitted, and at this station only. The article of Dr. Duncan does not mention an interesting feature of the Stone system which has been the subject of a number of patents. This consists in the use of two transmitting antennæ, each sending out waves of a definite but different frequency, and two receiving antennæ connected with the same number of sifting circuits. Signals are simultaneously transmitted in two frequencies. The receiver is controlled by a relay in connection with the two sifting circuits in such a manner that it only acts when both circuits are simultaneously receiving the two frequencies

sent from the receiving station. It may be added that a similar "Yale lock" system of selective wireless telegraphy is also the subject of patents issued to Mr. Nikola Tesla.

The Mechanism of Electrical Energy Transfer.

Elsewhere we print an elegant generalization by Dr. Kennelly on the mechanism of electric power transmission, that term including Hertzian as well as alternating and direct-current transmission. In the minds of most people there is a wide distinction between simple direct-current phenomena and those of alternating currents, owing to the complexity of the latter due to inductive and capacity effects; while Hertzian wave phenomena as ordinarily explained introduce a distinct and abstract order of ideas having few or no points of contact with those employed in the usual treatment of direct and alternating currents. Though less familiar, the fundamental principles of Hertzian wave propagation are by far the simplest as compared with those of alternating and direct currents, and Dr. Kennelly first takes up the former for consideration, following with alternating currents, of which direct currents are treated as a special case. An admirable feature of the article consists in the employment of numerical examples to illustrate the direct application of the principles deduced. Aside from the test this affords of the correctness of deductions, the method is of immense value when a new order of ideas is treated, for it offers the mind a means of passage from the abstract with its pitfalls for all but the elect to the firm ground of the concrete.

The Permanence of Resistance Standards.

This year's report of the Committee of the British Association for the Advancement of Science, on Standards for Electrical Measurements, has recently been published, and contains a number of interesting statements. A number of standard resistance coils have been under the observation of the committee during many years. Some of the measurements extend as far back as 1864. It seems that since 1888 some of the standard platinum-silver resistance coils have changed slightly in value. Others do not appear to have changed appreciably. Out of ten standard coils reported upon, the maximum change in fifteen years has been an increase of one-tenth of one per cent., and the average change has been an increase of about one-sixtieth of one per cent., half of the coils only having shown any change. Individual measurements show both small increases and small decreases, the decreases being only about half as frequent as the increases. The general average tendency is to a slight increase. It seems safe to say, therefore, that while, for most practical purposes, a platinum-silver standard resistance coil has constant resistance, yet where the greatest attainable accuracy is required, a platinum-silver standard coil may not have an entirely constant resistance. According to the results reported for the temperature coefficients of the same coils, their temperature-coefficients of resistance differ appreciably in some cases from those observed in 1888. The greatest change is about ten per cent. Nevertheless, the mean temperature coefficient of all coils is practically the same in 1903 as in 1888, and is 0.028 per cent., or approximately one-fortieth of one per cent. per degree Centigrade.

The Board of Trade standard international ohm is stated to be smaller than the accepted British National Physical Laboratory standard international ohm by about the seventieth part of one per cent. The mercury tubes of the British National Physical Laboratory constructed to represent the international ohm agree with those constructed at the German Reichsanstalt to about one-seven-hundredth part of one per cent. Comparisons between measurements of various coils made at the Reichsanstalt and at the British National Laboratory agree to about one-hundredth of one per cent. Such comparisons are as much tests of thermometers as of resistance, since a small difference of temperature between the coil and the thermometer may give rise to errors of the magnitude here considered. It thus appears that the standard of the international ohm kept at the London Board of Trade Laboratory, at the British National Physical Laboratory and at the Reichsanstalt are all within one-sixtieth of one per cent. This is about the degree of certainty which seems to prevail in the scientific world at the present time concerning standards of electrical resistance. If a resistance coil be sent to these various laboratories to be measured, the three reports may seemingly be depended upon to agree within one-sixtieth of one per cent., and often within one-hundredth of one per cent. This degree of accuracy is far greater than existed only a few years ago.

The definition of the concrete standard international ohm as agreed upon by the International Electrical Congress of Chicago in 1893, was the resistance of 106.3 cm. of mercury weighing 14.4521 grammes at 0° C. This means a column of mercury one square mm. in cross-section. According to the report, this column is slightly too long to represent the ohm, and should be reduced to 106.291 cm., so that the existing concrete international ohm is about one-hundredth of one per cent. bigger than the true ohm of physical theory. If this is the case the Chicago congress overshot the mark. The original B.A. ohm represented 104.8 cm. of sq. mm. mercury column. Then the Paris 1884 congress advanced the length to 106 cm. as a round number, and the Chicago congress went as far as 106.3 cm., although many experimentalists reported results lower, and some as low as 106.2 cm. According to the present report, the correct length should be 106.291 cm. Except for measurements of great accuracy, it is evident that we may all feel well contented with the international ohm of the Chicago congress. The report also considers the resistance of a metre-gramme of copper at 60° F., or 15.55° C. In 1860 Matthiessen published a value for the resistivity of the purest copper he could get, which corresponds to 0.150 international ohm. Modern electrolytic copper is stated to range between 0.1475 ohm and 0.1492 ohm. Taking a mean of 0.1485 ohm, it transpires that modern good commercial copper has one per cent. higher conductivity than Matthiessen was able to secure in 1860, or has a conductivity of 101 per cent. of Matthiessen's standard. There is, in fact, no difficulty in securing 99 per cent. of Matthiessen standard conductivity in ordinary good samples of commercial copper wire. The report incidentally accepts the density of copper as 8.91.

If the standard international volt were in as satisfactory a condition of accuracy as the international ohm, we should be very much better off than we are. We have recently pointed out in these columns that the concrete standard of e.m.f. as defined by the International Electrical Congress of Chicago, in terms of the Clark cell, is uncertain to the extent of about the one-fourteenth of one per cent. Consequently, attention to this standard in the near future is more necessary than to the standard ohm. With the international ohm comfortably settled to about one-hundredth of one per cent., research should next be directed to correcting and establishing the concrete value of the volt. An error of one-fourteenth of one per cent. is almost an error of practical importance in electric lighting and its technical work. The international ampere was defined by the International Electrical Congress of Chicago by its electrolytic effect in a standard bath of silver nitrate solution, i. e., in a silver coulombmeter. This value is likewise subject to a small range of uncertainty, and it is probable that if the volt could be reproduced at will from a concrete standard to an accuracy of one-sixtieth of one per cent., it would be better to reproduce the concrete standard ampere indirectly by reference to the volt and the ohm, instead of directly by electrolytic effect.

Annual Report of the Western Union System.

The annual report of the Western Union Telegraph Company, published last week, is an encouraging document and bears out the showing made by the previous quarterly report. The net earnings for the year were $922,143 greater than those of the previous year. The surplus of the company on June 30, including the surplus earnings of the year just passed, was $13,019,725.

The increase of $1,094,592 in the revenue of the company represented an increase of $321,760 from the transmission of regular messages and an increase of $282,774 from leased wires, the balance coming from sundry other sources. The earnings and disbursements as compared with the previous year were as follows:

	1903.	1902.
Revenues	$29,167,686.80	$28,073,095.10
Expenses	20,953,215.07	20,780,766.21
Net revenue	$8,214,471.73	$7,292,328.89
Interest on bonds	1,077,700.00	992,580.35
Profits	$5,136,771.73	$6,299,748.54
Appropriated for dividends	4,868,050.00	4,868,031.25
Surplus	$2,268,721.73	$1,431,717.29

The expenses in detail were: Operating and general expenses, including taxes, $15,553,337.31; rentals of leased lines, $1,567,705.98; maintenance and reconstruction of lines, $3,431,822.21; equipment of offices and wires, $400,349.57; total expenses, $20,953,215.07.

During the year the company transmitted 69,790,866 messages, an increase of 415,983 over the previous year, these figures not including the equivalent of about 10,000,000 messages sent over leased wires. There were added to the company's system 402 miles of poles and 59,228 miles of wires, of which 47,000 miles were of copper. In the number of offices there was a decrease of 447 from 23,567 in 1902 to 23,120 in 1903. This may reflect the closing of certain offices along the lines of the Pennsylvania Railroad. On June 30 the company was operating 196,517 miles of poles and cables.

The company's new railroad business secured during the year consisted of contracts covering 3,840 miles of railroad, including the St. Louis Southwestern Railway Company, East Carolina Railway Company, Manitou & Pike's Peak Railway Company, Boston & Maine Railroad Company, Nevada Central Railroad Company, Manhattan Railway Company and a number of divisions of the Brooklyn Rapid Transit system.

President Clowry says, in his report: "Since my last report the reorganization of the service has been completed. The system of thorough inspection, including our Atlantic and Cuba cable terminals, has been continued, and a further reduction of expenses has been effected, bringing the total up to $612,000 per annum."

The general balance sheet as of June 30 last is as follows:

ASSETS.

Telegraph lines, stocks owned of leased telegraph companies that are merged in Western Union Company's system, franchises, patents, etc.	$112,073,906.15
Stocks and bonds of leased telegraph companies received in exchange for collateral trust bonds	8,504,000.00
Stocks of not leased telegraph companies, and other securities	11,459,415.96
Real estate	4,765,130.54
Supplies and material in supply departments	498,010.76
Sundry accounts receivable, etc.	2,156,265.12
Cash in treasury and in hands of agents (since remitted to treasury)	2,678,015.73
	$142,134,744.26

LIABILITIES.

Capital stock	$97,370,000.00
Funded debt	24,504,000.00
Gold and Stock Telegraph Company for stocks of other companies held through lease of that company until 1981	1,946,592.00
Sundry accounts payable, etc. (including dividend July 15, 1903)	3,696,243.68
Surplus of income prior to Oct. 1, 1881, appropriated for construction and acquisition of telegraph lines and property (in excess of the $15,526,590 capital stock distributed in 1881 on account of such appropriations of income during the 15 years preceding)	1,598,184.03
Surplus of income subsequent to Oct. 1, 1881, ($12,389,964.64) plus the proportion of surplus of income prior to Oct. 1, 1881, ($629,759.91) that was not appropriated as above	13,019,724.55
	$142,134,744.26

The following table gives some interesting statistics:

	1903.	1890.	1880.	1867.
Miles of pole and cable	196,517	183,917	85,645	96,270
Miles of wire	1,089,212	678,997	233,534	85,291
Offices	23,120	19,382	9,077	2,565
Messages	*69,790,866	55,878,762	29,215,509	5,879,282
Receipts	$29,167,687	$22,387,029	$12,782,894	$6,568,925
Expenses	20,953,215	15,074,304	6,948,957	3,944,006
Net revenue	$8,214,472	$7,312,725	$5,833,937	$2,624,919
Av. toll per message	31.4	32.4	38.5	.....
Av. cost to Co. per message	25.6	22.7	25.4	.....

* Not including messages sent over leased wires or under railroad contracts.

Of the new circuits 47,000 miles of wire were of copper and $3,351,645 was spent during the year on construction.

Enormous Expenditures for Chicago Traction.

The extension ordinance for the Chicago City Railway Company has been completed and is in the hands of the local transportation committee. It is accompanied by two reports, one from the engineers of the street railway company and one from the city's experts, showing that from $15,000,000 to $17,000,000 should be expended in the rehabilitation of the traction system. In estimating the amount needed for the improvement of the Chicago city lines the city experts have placed the figure 6 per cent. lower than the company's estimate, it being the purpose of the company, it is claimed, to beg out of high compensation with the plea of great outlay for improvements.

The measure provides for the following: Joint use of tracks with the Union Traction Company wherever possible and exchange of transfers with that company's substitution of the underground trolley for the present cable system; immediate renovation of roadbed, plant and equipment, and maintenance of the lines in a first-class modern condition; removal of all dead tracks not used by the company and not required by public interest; use of the grooved rail in streets paved with granite, asphalt, brick or wooden blocks; use of cars with center aisles and without footboards entire length of sides; sprinkling streets for their entire width and the sweeping of them if possible by car sweepers and sprinklers, and the removal of garbage and refuse by street cars if possible; use of poles by the city for stringing wires; making of detailed annual reports by the company; whatever value may be conceded to the ninety-nine-year claims shall be determined in the adjustment of compensation and a waiver considered as part of this.

The extension ordinance has been accepted by the Chicago City Railway Company, it is said, in every feature except compensation. No amount is specified by the clause dealing with this. This will be the obstacle in the measure. The company insists that 3 per cent. is high enough, while the aldermen declare such an amount to be ridiculous, and hold out for 20. The grant is for twenty years. At the expiration of that time the city may acquire the property by purchase, may let another company take it, or may renew the grant.

It is expected that the Union Traction interests will oppose a separate settlement with the Chicago City Railway Company because an extension ordinance once having been granted the latter, that hereinafter granted to the Union Traction Company will have to be similar and the former company is in position to give much better terms to the city. If the compensation can be adjusted to the satisfaction of both city and company, it is probable that the south side extensions will be granted as one of the first acts in franchise legislation this fall.

Six applications for six different permits have been made by General Manager Roach, of the Union Traction Company, on behalf of the receivers, to the Commissioner of Public Works. Speedy litigation to define the scope of the ninety-nine-year act may be the result of the applications depending entirely on the answer the city makes to the request. If it gives consent absolutely or with such limitations as the authorities deem safe, that will be the end of the matter. If the application is refused then an application to Judge Grosscup for instructions based on rights claimed under the ninety-nine-year act will follow, and out of the orders he may issue will come the test of the act.

Judge Grosscup has made permanent his injunction of August 15 prohibiting the attorneys for the minority stockholders objecting to the plan of reorganization of the Union Traction and its underlying companies from attempting to interfere with that reorganization. This will permit the minority to perfect an appeal for the October term of the United States Court of Appeals.

Transmission of Hudson River Power.—I.

ENERGY from the Hudson River is to displace more than 40,000 hp of steam apparatus in the triangular territory between Albany, Schenectady and Glens Falls, N. Y. The extent of this territory in a direct line between Albany and Glens Falls is about 45 miles, and the cities of Albany and Schenectady are 15 miles apart. Within the area named are Troy, Albany, Schenectady, Cohoes, Lansingburg, Ballston Spa, Saratoga, Fort Edward, Sandy Hill and Glens Falls, with an aggregate population of 300,000.

This water power is to be transmitted from two generating stations owned by the Hudson River Water Power Company, one located at Spier Falls and the other at Mechanicsville. From these generating plants a network a transmission lines extends to all the cities and towns above named, and also to a number of electric railway sub-stations scattered over the territory. A part of the energy developed at these two water power plants goes to sub-stations owned by the company at Glens Falls, Saratoga and Ballston Spa, where the local systems of electrical supply are also in the hands of the company. Besides the energy required for these systems the Hudson River Water Power Company has contracts with the following companies for the delivery of the amounts of power named, as soon as the water power plants can deliver it, or by fixed dates: General Electric Company, 10,000 hp; United Traction Company, of Albany, 6,000 hp; Hudson Valley Railway Company, 2,000 hp; Municipal Gas Company, Albany, 8,000 hp; Troy Lighting Company, 8,000 hp; Glens Falls Portland Cement Company, 1,000 hp.

These contracts, it will be noted, aggregate 35,000 hp, without taking any account of the regular lighting and motor loads in Glens Falls, Saratoga and Ballston Spa, where the company is now operating the electrical supply systems. Besides all the above, applications are on file for more than 6,000 hp for use in Saratoga, Glens Falls, Ballston Spa, Sandy Hill and Fort Edward.

In order to carry the total of the loads just named, the new power plant at Spier Falls and the remodeled plant at Mechanicsville are being pushed to completion as fast as possible. The ELECTRICAL WORLD AND ENGINEER of June 27, 1903, gave some account of the water power development at Spier Falls, and of the great dam and power house going up there. As then noted, the capacity of the ten main generators at Spier Falls will be 24,000 kw, or 32,000 hp at normal rating. In the Mechanicsville plant the normal generator capacity for the seven units is 7,000 hp, giving thus a normal rating of 39,000 hp for the two water-driven stations. Both plants when completed will have water wheels with materially larger capacities than the generators to which they are connected, so that the generators can be overloaded to some extent when desirable.

Since the former matter was written on the plant at Spier Falls work on the dam and the foundations of the power house has gone rapidly forward, so that the two 2,000-kw and one of the 2,500-kw generators are in operation, though the full head of 80 ft. of water is not yet available for their wheels. At the present time a portion

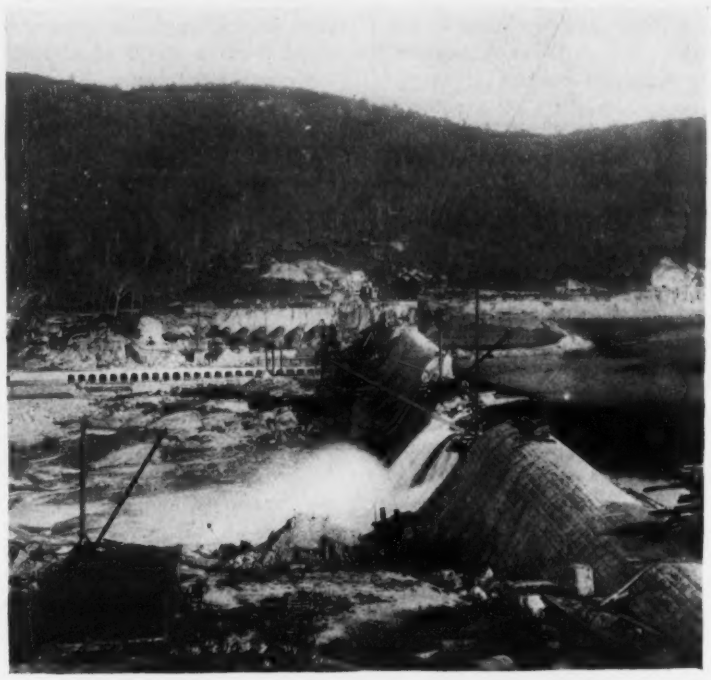


FIG. 2.—DAM AT SPIER FALLS.

of the overflow section of the dam has been left a few feet below its final level, pending the completion of the river section, and the head of water at the wheels is about 60 instead of 80 ft., the final figure. In spite of this reduced head the generators are carrying their loads in a satisfactory way, because of the large capacities of their wheels. The foundation of the power house as well as its floor is entirely concrete masonry above the natural rock of the river bed and bank. This foundation and the floor of the power house have been completed, so that it is possible to erect and operate the generators, though the remainder of the power house is lacking, and so urgent is the demand for power that this has already been done as above noted. To protect the generators, transformers and other apparatus

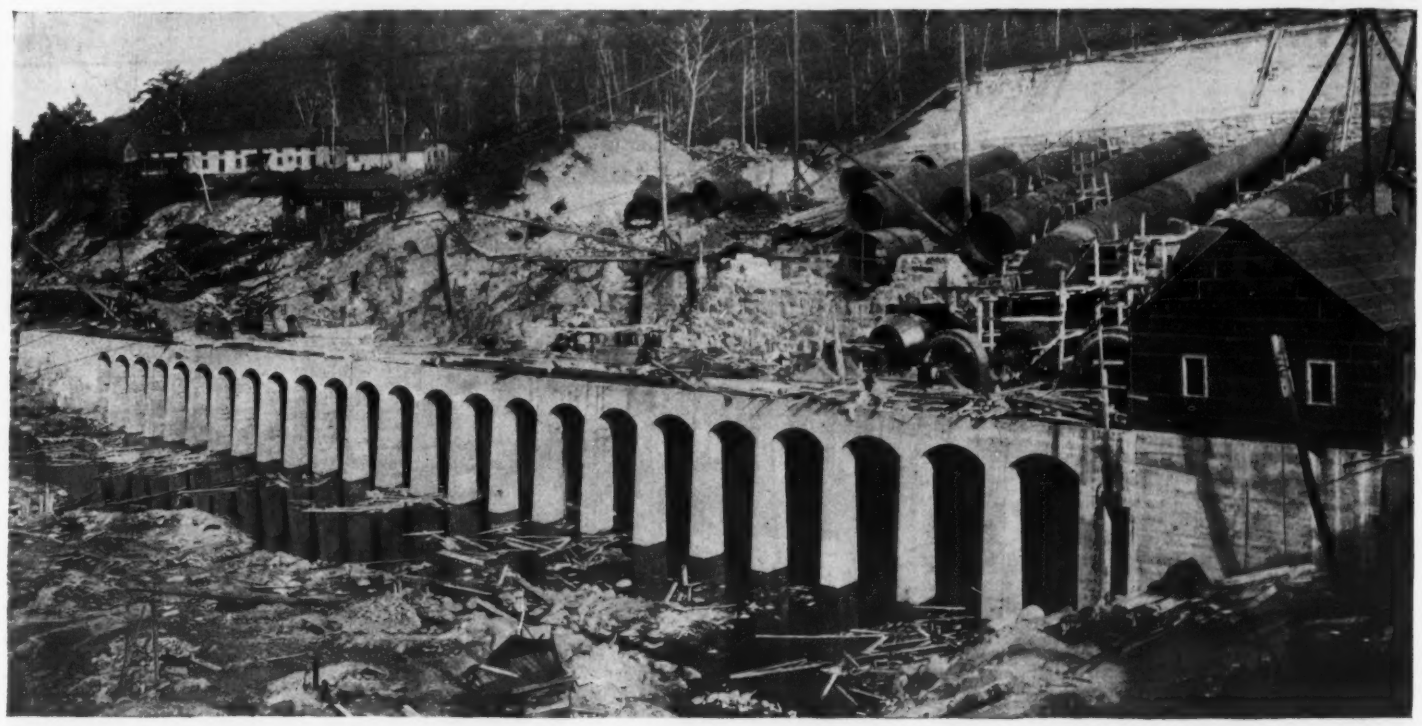


FIG. 1.—FOUNDATIONS OF POWER HOUSE AT SPIER FALLS.

a temporary wooden building has been erected pending the completion of the brick power house.

This power house when finished will be 70 ft. 10 in. x 392 ft. inside, save that a space 28 ft. x 34 ft. is omitted at one corner. A space extending across the entire width of the building and 40 ft. in the direction of its length is devoted to the transformers and the high and low-tension switchboards. The remainder of the power house is divided into two parts in the direction of its length by a watertight brick partition that gives the wheel room a width of 34 and the generator room a width of 35 ft. Along the outside wall of the wheel room ten steel penstocks each 12 ft. in diameter enter from the canal. Each of eight of these penstocks supplies water to one pair of horizontal turbine wheels that discharge through a single draft tube, and are direct-connected to a 2,500-kw generator. Each of the other two penstocks supplies one pair of wheels that is direct-connected to a 2,000-kw generator and also a wheel connected to a 200-kw exciter. Each of the pairs of wheels is regulated by a Lombard governor. The 2,500-kw generators operate at 240 r.p.m., 40 cycles, three-phase and 2,000 volts. The 2,000-kw generators have a speed of 300 r.p.m. and also develop 40-cycle, three-phase, 2,000-volt current.

That section of the power station containing the transformers and switchboards adjoins the dam and has a basement underneath the main floor. This basement with the dam for one of its side walls and its floor, roof and other sides formed of concrete masonry, contains a central air chamber where a pressure of 5/8 ounce per sq. in. is maintained by blowers in order to force air through the transformers that sit on the main floor above it. On that side of this air chamber which is nearest to the main generator room is the low-tension switchboard, where the 2,000-volt current from the generators is received. On the opposite side of the air chamber and basement is the lower portion of the 30,000-volt switchboard, the upper part of

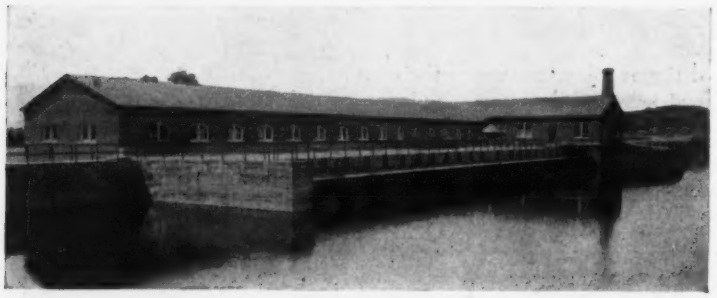


FIG. 3.—GENERAL VIEW OF MECHANICVILLE POWER HOUSE.

which runs above the main floor. With this latter switchboard are included the motor-operated oil switches, through which the 30,000-volt windings of the transformers are connected to the transmission lines. Each phase of these switches is contained in a separate brick compartment. The 30,000-volt connections are mounted on the stone and concrete masonry by means of Locke porcelain insulators. Each insulator for this purpose is secured to an iron pin and has a cast-iron cap. The joint between the pin and insulator, and also the joint between the insulator and the iron cap is made with a thin mortar of neat Portland cement. Insulators with pins and caps of this sort are used to support not only the connections but also the knife switches for the 30,000-volt lines. One of these knife switches is located in each wire on each side of every oil switch, so that the oil switch may be entirely disconnected from the line wires and transformers when any work on the switch is to be done.

In the complete equipment of the Spier Falls station are included thirty transformers of the air-blast type, designed to operate at 2,000 volts primary and either 15,000 or 30,000 volts secondary. Each of 24 of these transformers is rated at 833 kw, and each of the other 6 transformers is rated at 670 kw. The 833-kw transformers are connected in groups of three with the 2,500-kw generators, and each group of three 670-kw transformers is connected to a 2,000-kw generator. Six three-phase transmission circuits are to leave the Spier Falls station, and each of the eighteen wires that make up these circuits will be connected to a ground plate through a knife switch and a series of twelve lightning arresters mounted in a stone and brick cell. Each of these lightning arresters is of General Electric make and includes two carbon resistance rods and five brass cylinders with four air-gaps between them, all mounted on a porcelain base. The length of the air-gaps between cylinders varies somewhat and appears to range between 1/32 and 1/16 in.

Each of the two exciters at the Spier Falls station has a capacity of 200 kw and is driven by water from one of the penstocks that supply the wheels of the 2,000-kw generators. The operating switchboard is located in front of the row of main generators and about midway of the length of the station. On this operating board are the switches that start the motors on oil switches of the high-tension

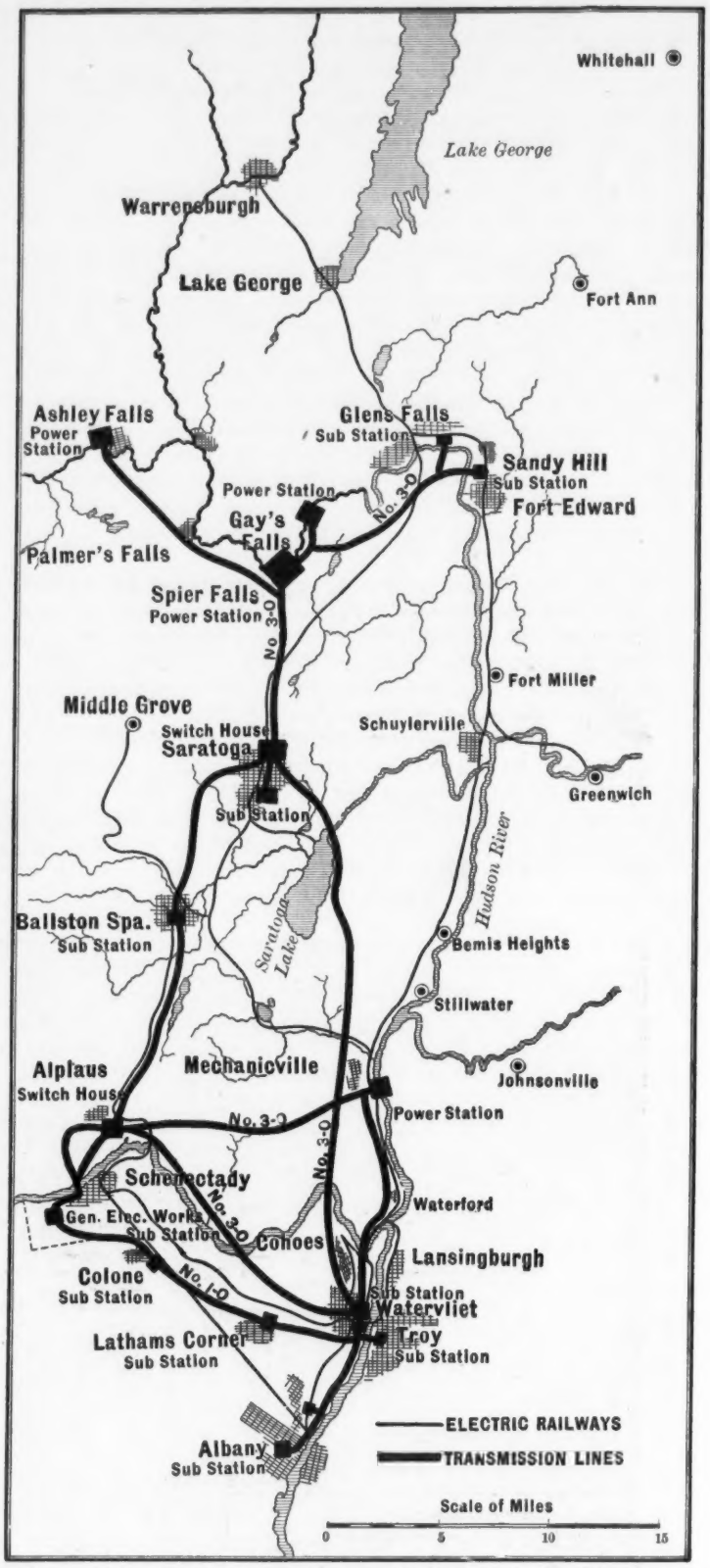


FIG. 4.—MAP SHOWING LOCATION OF GENERATING AND SUB-STATIONS AND THE TRANSMISSION LINES.

lines. Besides the equipment of indicating meters there are also recording wattmeters for the entire output. About 25 miles in a direct line from the Spier Falls station, though at a somewhat greater distance by the course of the river, is the second water power plant of the Hudson River Water Power Company, namely, that at Mechanicsville. This plant, as at first built, was completed in 1898, and described by the ELECTRICAL WORLD AND ENGINEER in September of that year. The Hudson River at the point where the dam and

power house were built has a total width of about 1,200 ft. At a distance of about 800 ft. from the eastern bank of the river a rocky island divides the channel into two parts, and across the greater of these parts the main or overfall section of the dam was built. The length of the overfall section of the dam between abutments is 707 ft., but the spillway has recently been increased 143 ft. by the removal of the soil from the ledge at the eastern end of the dam, and the construction of a crest there that is one foot higher than the crest of the original overfall section. This section stands 15 ft. above the bed rock of the river, is 16 ft. thick through its base, 8 ft. just below the crest, and 30 ft. thick through the base and apron.

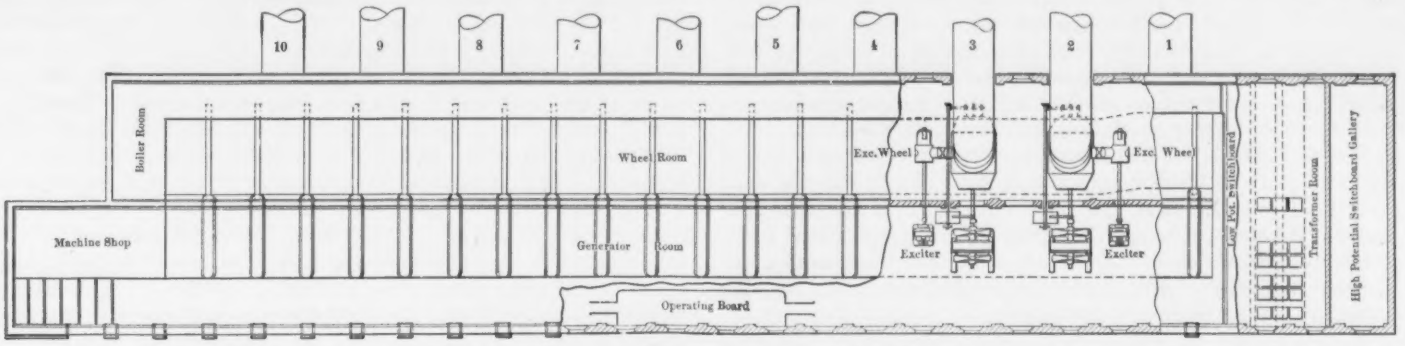


Fig. 5.—Plan of Foundations of Spier Falls Power House.

From the western bank of the river the power station extends a distance of 215 ft. toward the island, and the remaining width of the channel is closed by a dam 26 ft. high, 10 ft. wide on top and 18 ft. wide at the base. In the section of dam last mentioned are four arched waste gates each 4 ft. wide and 6 ft. 9 in. high.

In the western abutment of the main dam there are 12 waste gates each 4 ft. wide and 6 ft. high. From the foregoing it may be seen that the power house forms one section of the dam across the western channel of the river. In total length the power house measures 257 ft. 6 in., and its width up and down stream in the river section is 66 ft. 6 in. Of this total width the wheel chambers on the upstream side take up 32 ft. 6 in., and the generator room on the downstream side has 34 ft. Up to the level of the floor of the generator room the power house, like the dam, is constructed of concrete masonry, but imbedded in the concrete arches and piers beneath the power house are steel I beams and columns. Above the main floor on the downstream side, and above the wheel chambers on the upstream side, the power house walls are of brick with steel columns at intervals that carry the steel roof trusses and the traveling crane of 20-tons capacity. The upstream half of the power house is divided into nine wheel chambers which have arched concrete

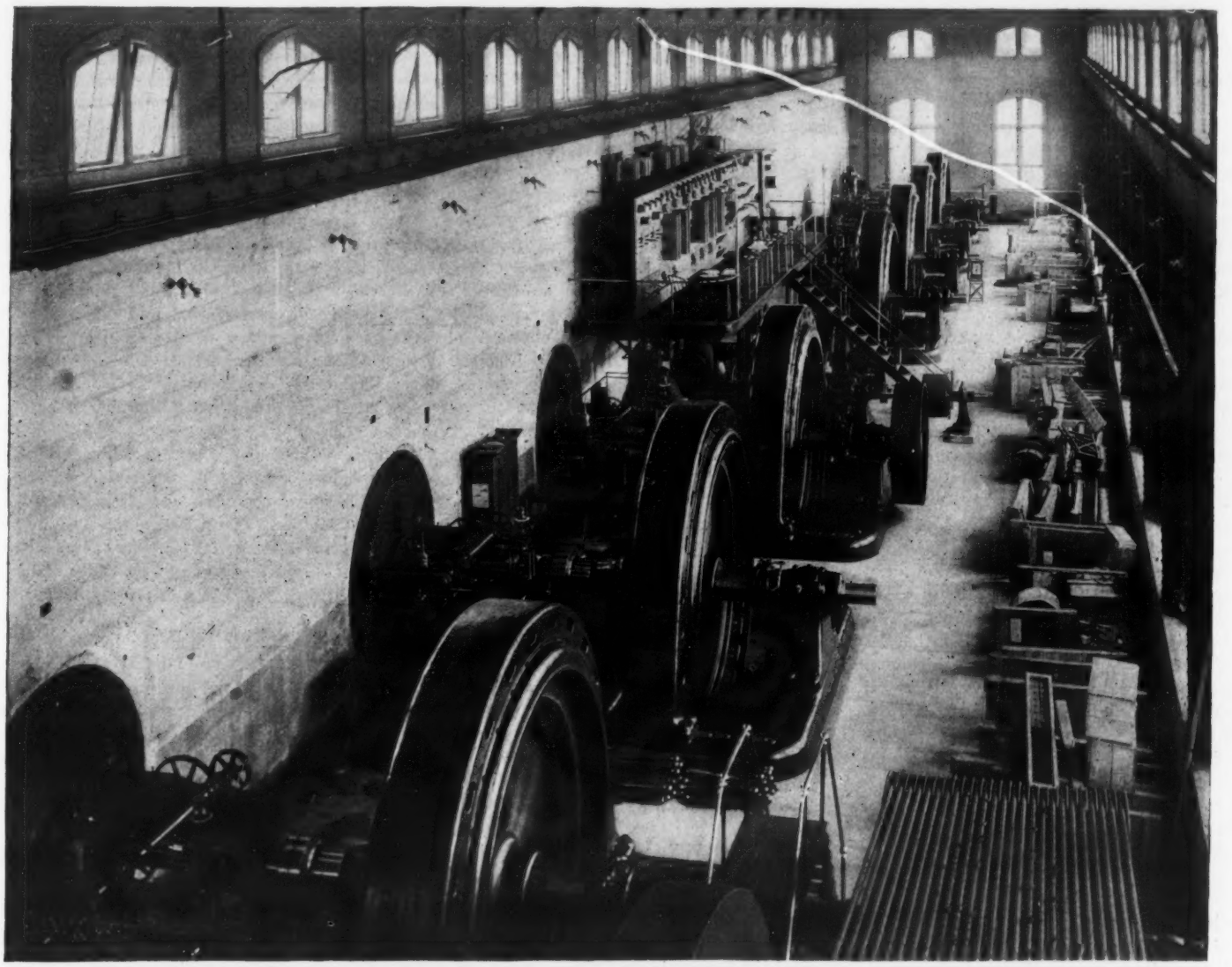


Fig. 6.—View of Interior of Mechanicville Power Station.

roofs as well as concrete floors and sides. The head wall that separates each wheel chamber from the generator room is 6 ft. thick and is fitted with a large bulkhead of cast iron that carries a watertight bearing for the wheel shaft. Each wheel chamber connects with the west channel of the river through an arched opening at its upstream end, and this opening is protected by an iron rack to intercept floating objects. Seven of the wheel chambers are designed for wheels that operate the main generators, and each of these chambers is 32.5 ft. long, about 18 ft. high, and 23 ft. wide approximately. The head water level in each wheel chamber is 49, and the elevation of the tail water underneath is 31, under normal conditions, so that the effective head on the wheels is about 18 ft. at best. Each set of main wheels is set with its shaft 7 ft. below the normal head water, and 11 ft. above the normal tail water level, and the draft tubes extend some distance below the tail water. As at first constructed by another company, the highest points of the arched openings at the upstream ends of the main wheel chambers were about 2 ft. below the level of the river at that point, but since the plant has come into the hands of the Hudson River Water Power Company a large amount of concrete has been cut from the tops of these arched openings, so that the head water can the more readily flow to the wheels.

In each main wheel chamber four 42-in. diameter turbine wheels were originally mounted on the horizontal shaft, and each pair of these turbines was provided with its own draft tube. Each main wheel shaft, after passing through the cast-iron bulkhead, is coupled to the shaft of a 750-kw or 1,000-hp generator. The four 42-in. wheels were rated to deliver 1,000 hp, but these wheels proved to be too small to drive the 750-kw generator at full load and overload under the variations of head due to changes in the flow of the river. To remedy this defect the 42-in. turbines have recently been replaced by others of 51 in. diameter each. These 51-in. wheels are mounted four on each shaft, like the former ones. The horizontal shafts carrying the turbine wheels just named have a speed of 114 r.p.m. and drive the connected generators at that rate. S. Morgan Smith Company is the builder of the new 51-in. turbines. Each of the two exciters is driven by three 18-in. Victor wheels mounted on the same shaft and operating at 250 r.p.m. All water wheel governors, of which there is one for each set of wheels, are the product of the Lombard Governor Company.

Each of the seven shafts driven by the larger water wheels is direct-connected to a 750-kw, 12,000-volt, three-phase, 40-cycle generator of General Electric make, and these generators are of the internal revolving magnet type. Current for the magnets of these generators is supplied by two 100-kw, 125-volt exciters, each direct-driven by three of the 18-in. wheels. To provide for the contingency of low water, two Heine water tube boilers rated at 505 hp each, and one Hamilton Corliss tandem-compound engine with cylinders 24 x 48 x 48 in., and rated at 1,000 hp, has been installed. This engine is connected by a rope drive to a short shaft that can be readily coupled to the shaft of the 750-kw generator nearest the river bank when desired.

A switchboard gallery is located on the upstream side of the generator room, and oil switches for all of the 12,000-volt generators and transmission lines are operated from this gallery. A part of these oil switches are operated by hand and a part by motors, but both these types of switches are located in separate fire-proof compartments, the manual switches being beneath the gallery, and the motor operated at one end of the station. These oil switches were all made by the General Electric Company. Air-break switches were at first installed in this station, but they did not prove satisfactory on the 12,000-volt generators and circuits.

In addition to the existing stations at Spier Falls and Mechanicville the Hudson River Water Power Company owns a large water power at Ashley Falls, about ten miles northwest of Spier Falls, on the Sacandaga River, and another large power at Gay's Falls, about three miles downstream from Spier Falls on the Hudson River. It is the intention of the company to develop the powers at Ashley and Gay's Falls in the near future.

From the plants at Spier Falls and Mechanicville current is to be transmitted to sub-stations of the Hudson River Water Power Company at Glens Falls, Fort Edward, Saratoga, Ballston Spa and Watervliet. The Glens Falls, Saratoga and Watervliet sub-stations are already in operation, and construction of the Fort Edward and Ballston Spa sub-stations is underway.

Besides its own sub-stations just named, the water power company is delivering energy to a number of sub-stations along the line of the Hudson Valley Railway, which extends from Troy to Mechanicville, Saratoga and Glens Falls, to sub-stations of the Schenectady Street Railway at Ballston Spa, Schenectady, Colone and Latham's Corner, to a sub-station in the General Electric Works at Schenectady, to sub-stations of the United Traction Company, of Troy and Albany, located at North Albany and Watervliet, respectively, to a sub-station of the Albany Electric Illuminating Company, to the Lighting Company, of Troy, and to a sub-station of the local lighting company in Lansingburg.

To transmit energy from the plants at Spier Falls and Mechanicville to the various sub-stations named the following three-phase circuits will be employed, all circuits being made up of copper wires hard-drawn and solid. Between Spier Falls and the sub-stations at Glens Falls and Fort Edward, a distance of about 10 miles, there is a single circuit of 3/0 wire. From Spier Falls to Saratoga switch house three circuits of 3/0, and two circuits of 1/0 wire will be employed. One circuit of the 1/0 wire goes from Saratoga switch house to Saratoga sub-station, a distance of about two miles, and terminates there. Two of the 3/0 circuits pass from the Saratoga switch house to the sub-station of the Hudson River Water Power Company at Watervliet, which is about 35 miles from the power plant at Spier Falls.

The remaining, one 1/0 and one 3/0 circuits, go from Saratoga switch house to Alplaus switch house, which is about five miles from the sub-station in the General Electric works at Schenectady. From Alplaus switch house two 3/0 circuits pass to the General Electric sub-station, distant about 32 miles in a direct line from Spier Falls. Both the circuits between Saratoga switch house and Alplaus switch house pass through the sub-station at Ballston Spa, which is 17 miles south of the generating plant. Alplaus switch house is connected with the water power company's sub-station at Watervliet by one circuit of 3/0 wire. Between this Watervliet sub-station and that of the Albany Electric Illuminating Company there are two circuits of 3/0 wire. This Albany sub-station is about 41 miles in a direct line from Spier Falls, but the distance by line is somewhat greater. The sub-station of the local lighting company in Troy is connected with the Watervliet sub-station by two 3/0 circuits, and the last-named sub-station feeds that of the United Traction Company at North Albany over one circuit of 1/0 and one of 3/0 wire. A circuit of 1/0 wire connects the Watervliet sub-station of the power company with the Latham's Corner sub-station of the Schenectady Street Railway, and this circuit has been continued by the railway company to the sub-station in the General Electric Works. Three circuits each of 3/0 wires leave the water power plant at Mechanicville. Two of these circuits pass to the Watervliet sub-station and one goes to the switch house at Alplaus.

Of the above-named circuits, three of 3/0 wire between Spier Falls and Saratoga switch house, and two of 3/0 wire between Saratoga switch house and Watervliet sub-station have not been erected, but it is the intention to complete them at an early date. When the power plants at Gay's Falls and Ashley Falls are in operation their transmission lines will join those already named at Spier Falls.

A Plea for Punctuality.

The *New York Tribune* says: "With the opening of the season of medical, electrical and other scientific conferences, a familiar characteristic of such meetings in this city is brought into fresh prominence. The members are rarely called to order until ten or fifteen minutes after the appointed time. Not infrequently the delay is greater. Similar tardiness may be observed in formally opening the proceedings of charitable and social organizations, and such laxity is not without its drawbacks. Comment is confined here, however, to the group of gatherings first named, because a lack of punctuality among scientific people is, after a fashion, inconsistent with that exactness of thought and statement which the world expects from them and on which they occasionally pride themselves. Men who are trained to precision of observation and utterance might reasonably be expected to be exceptionally scrupulous in keeping engagements. Any shortcomings in this respect become even more conspicuous when a comparison is made with the promptness with which bank directors' meetings and church services begin, to say nothing of theatres and symphony concerts." The American Institute of Electrical Engineers and the New York Electrical Society will please take note.

On the Mechanism of Electric Power Transmission.

BY DR. A. E. KENNELLY.

THE mechanism of electric power transmission in an electric circuit over wires is essentially of the same nature as the mechanism of wireless telegraph communication. In the latter case electromagnetic waves, comprising electric and magnetic fluxes, with their energies, carry away the electric energy of the sending antenna, and run freely over the conducting surface of the earth, spreading and attenuating as they run. In the former case, the waves are guided over the surfaces of the wires and do not spread or attenuate, except by leakage or by absorption due to imperfect conductivity in the metal. In both cases electromagnetic fluxes escape from the source, and at the speed of light, and carry with them the energies pertaining to such fluxes. The key to the narrow channeled mechanism of wire telegraphy is found in the open field of wireless telegraphy.

In wireless telegraphy, owing to our present imperfect knowledge of the height and contour of the advancing waves above ground, we must be content with certain simple assumptions. Let us assume that all of the electric energy resident in a vertical sending antenna is utilized in radiation; or, that its radiation efficiency is 100 per cent.; also that this energy is all radiated in one double-oscillation or complete wave. That is to say, the radiation is to be monochromatic, and to be confined to one pair of alternations, as distinguished from a series of decaying oscillations. Let the single emitted wave be supposed to expand hemispherically in three dimensions, like a half bubble, and to run without any loss by conductive absorption over the surface of the earth, regarded as a smooth, perfectly conducting plane. None of these assumptions can justifiably be applied to a practical case; yet the results worked out on this basis are probably reliable so far as the nature of the mechanism is concerned, and may possibly be reliable, for practical purposes, as a crude working hypothesis, to a first approximation.

Suppose a vertical antenna, say 30 metres in height, charged to a potential of 30 kilovolts, and suddenly discharged to ground, with perfect radiation conversion efficiency. The capacity of the antenna may be about 0.01 microfarads, or 10^{-17} abfarad. The potential being 3×10^4 volts, or 3×10^{12} abvolts, the quantity of electricity in the antenna, just before discharge, will be 3×10^{-5} abcoulomb,

and the energy of this charge $\dfrac{3 \times 10^{12} \times 3 \times 10^{-5}}{2} = 4.5 \times 10^7$

ergs, or 4.5 joules, or 3.32 foot-pounds. This is the stock of energy for the outgoing wave.

On discharge, the 45,000,000 ergs are thrown off into space, at the speed of light, in the hypothetically assumed form of a hemispherical wave. Since the height of the antenna is a quarter wave-length, the thickness of the wave will be everywhere 120 metres, in two alternations of 60 metres each, the front half-thickness being say positive, and the rear half-thickness negative. At a distance of say 10 kilometres from the emitting antenna, the wave surface area will be $2\pi\ (1{,}000{,}000)^2 = 6.283 \times 10^{12}$ sq. cm., and the volume of the wave shell will be $12{,}000 \times 6.283 \times 10^{12} = 7.54 \times 10^{16}$ c. c. The mean voluminal energy of the wave will then be $\dfrac{4.5 \times 10^7}{7.54 \times 10^{16}} = 6 \times 10^{-10}$

ergs per c. c. If the wave were of the rectangular type graphically, i. e., of uniform amplitude in each oscillation, there would be 6,000 cm. of wave-shell in the positive half, and 6,000 cm. of wave-shell in the negative half; while in each of these half-shells the energy would be uniformly distributed at 0.0006 microergs per c. c. Half of this, or 0.0003 microergs, would be in energy of electric flux, and half in energy of magnetic flux. The magnetic energy would be of the type $\dfrac{\mathfrak{B}^2}{8\pi}$ ergs per c. c., where $\mathfrak{B}$ is the magnetic induction density in gausses. Consequently, $\dfrac{\mathfrak{B}^2}{8\pi} = 3 \times 10^{-10}$ ergs, whence

$$\mathfrak{B} = \sqrt{24\pi \times 10^{-10}} = 8.68 \times 10^{-5} \text{ gauss.}$$

The magnetic intensity of force $\mathfrak{H}$ would be 8.68×10^{-5} gilberts per cm.

The electric energy would be of the type $\dfrac{E^2}{8\pi}$, where E is the electrostatic induction. Consequently, by similar reasoning, $E = 8.68 = 10^{-5}$ C. G. S. electrostatic units of induction. The electric intensity in the wave would be 8.68×10^{-5} abstatvolts per cm (0.02604 volt per cm.). It is interesting to observe that if the electric quantities are expressed in electrostatic units, and the magnetic quantities in magnetic units, the numerical values of the electric intensity, induction-density and energy, are respectively the same as those of the magnetic intensity, induction-density and energy at the same part of any single electromagnetic wave whatsoever, whether in wire or wireless systems. This convenient property renders it necessary to compute one only of the magnetic and electric sets of values.

Since the electric flux paths are all vertical in the wave front at the ground, while the magnetic flux paths are all horizontal, a receiving vertical antenna, say 30 metres in height, 10 kilometres from the source, and cut by the advancing wave, will be in the condition of a single-wire dynamo-armature, whose armature wire, 3,000 cm. long, cuts a field of $+ 8.68 \times 10^{-5}$ gauss, at the speed of light, for a period of 0.02 microsecond, and then cuts a field of -8.68×10^{-5} gauss, at the same speed (3×10^{10} cm. per second) for another period of 0.02 microsecond. The e.m.f. generated in the dynamo will, therefore, be $3{,}000 \times 8.68 \times 10^{-5} \times 3 \times 10^{10} = 78.12 \times 10^5$ abvolts = 78.12 volts. This would be the momentary e.m.f. induced in the receiving antenna for 0.02 microsecond in the positive direction, and then for the next 0.02 microsecond, in the negative direction. That is, the e.m.f. induced at each instant in the antenna is parallel to the electric flux and e.m.f. brushing by in the wave shell. Moreover, with 0.02604 volts per cm. of wave-front elevation, and a receiving antenna of 3,000 cm., the total e.m.f. in the wave-front, bridged by the antenna, will be $3{,}000 \times 0.02604 = 78.12$ volts.

Consequently, we may regard the e.m.f. induced in the receiving antenna either as magnetically-induced by cutting horizontal magnetic flux, or as embraced and picked up, by the height of the antenna, from the vertical electric flux.

The waves emitted from the sending antenna would not, however, be of the graphical rectangular type, as above considered, but would naturally be of the sinusoidal type, in which case all the quantities considered, instead of being of constant magnitude throughout each alternation, would gradually wax to a maximum and wane to zero. The maximum would be $\sqrt{2}$ times greater than the uniform values above deduced. The maximum e.m.f's in the receiving antenna would thus be $\pm$ 110.5 volts.

On the same crude theory of no absorption at the ground, and hemispherical expansion, the voluminal energy of the wave would diminish inversely as the square of the distance from the source; but the intensities, inductions and induced e.m.f's would vary only inversely as the distance, so that at 100 km. the received e.m.f. impulse would reach maxima of $\pm$ 11.05 volts, and at 1,000 km. $\pm$ 1.105 volts.

There would also be a wave, or double oscillation, of alternating electric current on the surface of the earth, which would be relatively intense close to the sending antenna, and would fall off in strength inversely as the distance. In practice, with imperfect conduction of the earth, this alternating current would penetrate the ground to some depth, with loss of wave energy by absorption. The current wave on or in the earth would always be located at the foot of the advancing wave. It would consist of an electric charge or charges, moving out radially from the source at the light speed.

Turning now to the case of wire transmission, consider a pair of parallel insulated aerial copper wires, such as might be used for a single-phase circuit. Let a constant e.m.f. of e abvolts be applied to the sending end of these wires and assume, for the sake of simplicity, that the conductor-resistance and leakance are both negligibly small. Then the surge resistance, or resistance which the line will offer to advancing electromagnetic waves, is known to be $r = \sqrt{\dfrac{l}{c}}$ absohms, where l is the inductance per cm. in abhenrys, and c is the capacity per cm. in abfarads. But $l = \dfrac{1}{cv^2}$, where v is the velocity of light.

$$\therefore\ r = \frac{1}{cv} \text{ absohms.}$$

The initial current strength at the sending end, when the e.m.f. is applied, will be $i = \frac{e}{r} = e\,c\,v$ absamperes, and the initial power will be $e\,i = e^2 c\,v$ ergs per second. All of these are known electrical conditions of the circuit under the assumptions made.

If we take a pair of infinite parallel planes, 1 cm. apart and perpendicular to the two conducting wires, there will be an initial electric charge of $e\,c$ abcoulombs communicated to the centimetre length of the circuit, comprised between the two planes. This represents an electric energy of $\frac{e^2 c}{2}$ ergs stowed away in the centimetre slab of ether between the planes. There will be an initial magnetic energy of $\frac{l\,i^2}{2}$ ergs in the same slab. But $\frac{l\,i^2}{2} = \frac{e^2 c}{2}$ from the preceding equations; so that the initial energy contained in the slab will be $e^2 c$ ergs, half electric and half magnetic. It will reside in the electric and magnetic fluxes permeating the slab. But the fluxes in the slab move bodily along the wires at the speed of light, which is the same as though v slabs were emitted from the sending end per second, each containing $e^2 c$ ergs. Consequently, the initial rate of power transmission will be $e^2 c\,v$ ergs per second, and this is just the power rate from circuital considerations as stated above. Consequently, the phenomenon of the transmission of electric power over a circuit is the rush of v centimetre slabs of electric and magnetic flux per second over the wires, each slab carrying a definite amount of flux energy. The energy is carried wholly through the ether, but is guided by the wires.

There is an electric current on or in the wires and energy transfer in the ether outside them. If the wires conducted perfectly there would be no penetration of current below their surfaces. In practice, the electromagnetic fluxes on reaching the end of the circuit are partly absorbed and partly reflected, the reflected remnants coming back at light speed, to be again partly reflected at the sending end. A wave thus makes an indefinitely great number of journeys to and fro before being completely absorbed. After a brief period, in which the current is building up over the circuit, there is a long series of superposed waves whose resultant or sum is the steady current of Ohm's law. The law as to flux transmission of power applies to the steady state as well as to the initial state; but requires to have all the fluxes properly summed in regard to strength and direction, in order to arrive at the total power.

As an example of the preceding reasoning consider a pole line consisting of a pair of No. 00 A. W. G. copper wires suspended on insulators at a uniform interaxial distance of 18 inches (45.72 cm.). The capacity of these wires is (ignoring insulators) 0.009736 microfarad per mile of loop, or 6.049×10^{-23} abfarad per cm. of loop. The inductance of the wires, assuming perfect conduction, is 0.002955 henrys per mile of loop, or 18.36 abhenrys per cm. of loop. If we express the electrostatic capacity in electrostatic units, we multiply by v^2, or 9×10^{20}, and we have $C = 5.444 \times 10^{-2} = 0.05444$ abstatfarad per cm. The inductance per centimetre of the circuit in abhenrys is the reciprocal of the capacity per centimetre of the circuit in abstatfarads, and this is a remarkable general law applicable to all circuits, when the inductance within the substance of the wires is ignored.

If an e.m.f. of say 30 kilovolts, or 3×10^{12} abvolts, or 100 abstatvolts, be suddenly connected between the two wires at the sending end, the charge per linear centimetre will be $100 \times 0.05444 = 5.444$ abstatcoulombs. The electric energy of the charge will be $\frac{100 \times 5.444}{2}$ $= 272.2$ ergs. This will be the energy of electrostatic flux in any centimetre slab of the ether perpendicular to the two wires. The magnetic energy of the advancing flux will be equal to the electric energy. The total flux energy in any centimetre slab will thus be 544.4 ergs. But the fluxes advance along the wires at the speed of light, 3×10^{10} cm. per second. There are thus virtually 3×10^{10} slabs sent out from the source per second, each carrying 544.4 ergs. The total initial power transmitted will, therefore, be $3 \times 10^{10} \times 544.4 = 1.633 \times 10^{13}$ ergs per second, or 1.633 megawatts, reckoned on the basis of electromagnetic wave power. The surge resistance of the circuit at the sending end, neglecting conductor resistance, is

$$r = \sqrt{\frac{l}{c}} = \sqrt{\frac{18.36}{6.049 \times 10^{-23}}} = 5.51 \times 10^{11} \text{ absohms} = 551 \text{ ohms.}$$

The initial outgoing current will be $i = \frac{30{,}000}{551} = 54.44$ amperes, and the power of the initial current will be $e\,i = 30{,}000 \times 54.44 = 1{,}633{,}000$ watts, or 1.633 megawatts, reckoned on the basis of electric circuit laws, and agreeing with the computed transfer by electromagnetic fluxes.

As soon as the outgoing wave has had time, at light speed, to reach the distant end of the circuit, to be partially reflected therefrom, and to return to the sending end, the current and power will begin to be modified by superposition of successive waves, so that the final current and power may be very different from the initial values. The same theory, however, applies in the final state through a process of summation.

The electric transfer of energy in a circuit corresponds to the mechanism of rope transmission, in so far as it depends upon a constant definite velocity and a variable tension. In the circuit the velocity is the velocity of light and the pull is varied either by altering the applied e.m.f., or by varying the number of waves that can add up to make the final summation current.

If the applied pressure in the preceding case had been 3,000 volts, instead of 30,000 volts, the electric and magnetic energies in each slab would both have been one hundred times smaller. For the same final proportional resultant wave system in a circuit, the power transmitted must increase as the square of the applied pressure, because the number of slabs sent off per second does not vary, but the energy per cubic centimetre, or per slab, varies as the square of the impressed voltage. A high-pressure circuit is, therefore, one which compresses a relatively large amount of energy into the fluxes linked with the circuit; so that when these fluxes run to and fro over the circuit at light speed a relatively large amount of energy is carried with them.

Grouping of Cells to Obtain Maximum Current.

By W. J. Humphreys.

Elementary matters are never so trifling as to justify being passed by without proof; but while to some students one demonstration is clear, others may more easily follow a different one. This is the excuse I offer for submitting the following equations, which lead to the same conclusion that was so nicely found by Mr. Pierce in the issue of October 3.

As in his article:

Let I = current.
e = e.m.f. of one cell.
r = internal resistance of one cell.
R = external resistance of circuit.
p = number of cells in each "parallel" set.
s = number of such sets in series.
$n = p\,s$ = total number of cells.

Then

$$I = \frac{s\,e}{R + r\,\frac{s}{p}} = \frac{n\,e}{p\,R + r\,s} = \frac{n\,e}{\sqrt{(p\,R - r\,s)^2 + 4n\,R\,r}}$$

Since the value of $n\,e$ cannot change, its terms being constant, I is a maximum when $(p\,R - r\,s)^2 + 4n\,R\,r$ is a maximum. But $4\,n\,R\,r$ is also a constant, because its several terms have fixed values, and, therefore, the current is greatest when $(p\,R - r\,s)^2$ is least; that is, in the ideal case, when $p\,R - r\,s = 0$, or $R = r\,\frac{s}{p}$. In words, when the external resistance is equal to the battery resistance.

This is not, of course, an economical method of grouping cells since only half the total energy is available for external or useful work.

The Stone Wireless Telegraph System.

BY DR. LOUIS DUNCAN.

THE commercial future of wireless telegraphy depends largely upon the possibility of selective signaling. To attempt the extended application of wireless telegraphy without such a system would cause confusion and failure. It is not possible that any international agreement should help matters at the present time, for wireless telegraphy is such a new art that we cannot tell at present what its final development will be, and any restrictions that might be imposed would only confine and delay its improvement and application. The futility of any such agreement is evident to any one who has followed the past development of the art and has in view its future possibilities.

What has already been done is most encouraging. I think there is no doubt that signals have been sent across the Atlantic and under favorable conditions messages have been sent and received. And the methods and results have been steadily improved. In fact, it has been shown that as far as overcoming distance goes wireless telegraphy is a success. The efforts to make this signaling selective —that is, to make it possible for a station to communicate with a station selected out of a number of others without interfering with the others—has so far proved a failure.

Mr. Stone's system aims to do away with this difficulty. His work deals almost entirely with selective signaling. Broadly, he accomplishes his purpose by the use of a sending apparatus that emits simple harmonic waves of a determined period, not a number of waves of different periods, as in other systems; and a receiving

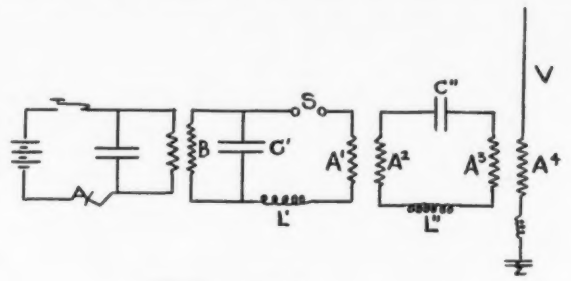


FIG. I.

apparatus that responds to a single period only. To do this he utilizes the properties of resonant circuits.

It is well known that a single circuit, including a capacity and inductance, has a definite period of electrical vibration, the expression for the frequency of this vibration being $n = \frac{1}{2\pi\sqrt{CL}}$, or if $p = 2\pi$, $np = \frac{1}{\sqrt{CL}}$. If e.m.f's of different periods, including the period of the circuit, be impressed on this circuit, the current due to the e.m.f. of period $p = \frac{1}{\sqrt{CL}}$, will be exaggerated, while those due to the other periods will be to a large extent suppressed. If, however, this circuit be placed in inductive relation with a second circuit, the natural periods of both circuits will be modified; but this modification will be unimportant provided $L'L''$ is great compared with M^2, L' and L'' being the respective self-inductions of the two circuits, and M their mutual induction. So by filtering an electric vibration of mixed period through a number of such circuits having the same period and placed in inductive relation, we can finally arrive at a vibration of a single period—that is, at a simple harmonic wave.

So far we have considered the natural vibrations of the system, but if an e.m.f. of a period different from the natural period of the system be impressed on it, it will execute "forced" electrical vibrations of a period equal to that of the impressed e.m.f. The mechanical analogy is exact and evident. If there are no frictional losses in the system—magnetic and dielectric hysteresis—and a simple harmonic e.m.f. of a given period be impressed on it, the result will be a simple harmonic current of the same period. This is the principle of Stone's transmission device, which I have shown in Fig. 1. An induction coil has a secondary, B, and a spark-gap, S. On a discharge taking place across the spark-gap, an oscillating discharge from the condenser passes through the circuit, $S\,A'\,L'\,C'$, this circuit being so tuned that it responds to the period desired. In inductive relation to it is a second circuit, $A^2\,C''\,A^3\,L''$, tuned to the same

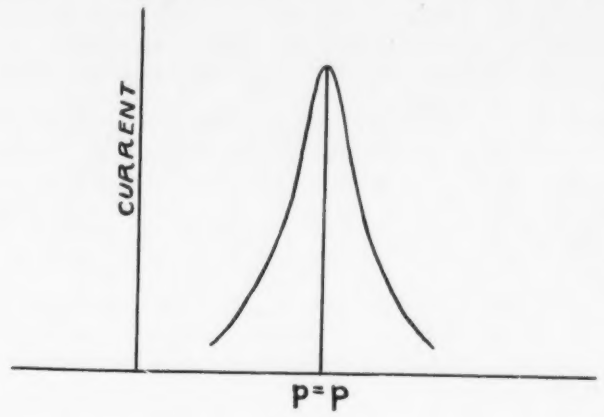


FIG. 2.

period and in turn placed in inductive relation with the vertical wire, v, through the coils, A^3, A^4. The coils, A^1, A^2, A^3 and A^4, consist of a few turns of wire (twenty is the greatest number in the apparatus used) wound on a wooden frame about 8 in. square and placed about ⅓ in. apart. The inductances, $L'\,L''$, are placed in the circuit to make the condition hold that $L'\,L''$ must be much greater than M^2; actually they are immeasurably small, but their values may be calculated from the dimensions. Any number of intermediate circuits similar to $A^2\,L''\,A^3\,C''$ might be used to still further purify the wave, but it is not necessary to multiply them.

The use of this apparatus gives this result: We have impressed on a continuous vertical conductor simple harmonic alternating waves of a definite and determined period. By changing the values of $L'\,C'\,L''$ and C^2 we may alter this period as we wish.

Now to turn to the receiving end of the system. If we have a resonant circuit such as we have been considering—that is, a circuit with concentrated capacity and inductance, as distinguished from distributed capacity and inductance—and place it in inductive relation with a circuit on which is impressed an alternating e.m.f., then as the period of this e.m.f. approaches the natural period of the circuit the current in the latter increases rapidly, reaching a sharp maximum when the two periods are equal. Fig. 2 shows such a state of affairs. If the impressed wave is not simply harmonic, but contains a number of waves of higher periods, then the maximum is not so sharp, and some part of the higher impulses appear in the resonant circuit. It is true, too, that even simple waves of different periods would cause the circuit to execute forced vibrations. To obviate this, and prevent impulses of a different period affecting the receiving devices, the same means may be employed as at the transmitting end, i. e., a second circuit tuned to the same period may be placed

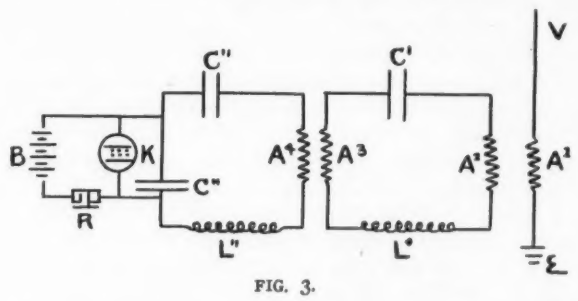


FIG. 3.

in inductive relation to the first and the receiving device placed in it. In this way a receiving station may be constructed that will respond, within narrow limits, to one period and to only one period.

This is the plan Mr. Stone has used. It is shown in Fig. 3. Here V is the vertical wire containing the coil, A', in inductive relation with the coil, A^2, of the resonant circuit, $A^2\,C'\,L^1\,A^3$, which is in turn through the coils, A^3 and A^4, in inductive relation with the circuit of equal period, $A^4\,C''\,C'''\,L''$. Across the condenser, C''', in the latter circuit, is the circuit of the receiving device.

In such an apparatus for receiving signals there is one matter that should be carefully considered. The magnitude of the effect on

the receiving apparatus due to a slight change of period of the impressed e.m.f. depends on the sharpness of rise of the resonant curve. In 1892, with Messrs. Carichoff and R. H. and G. E. Hutton, I made a number of experiments on resonant circuits and published a brief description of the work, giving a few quantitative results. We found that hysteresis losses in the circuits greatly decreased the effect of resonance, the introduction of a solid iron core into the inductance core used reducing the results to a small fraction of what was obtained by calculation from the resistance, inductance and capacity of the circuit. We found that dielectric hysteresis had the same effect. With the high frequencies used in wireless telegraphy these results are greatly exaggerated, and the presence of even slight amounts of hysteresis will mask all of the effects and render the method inoperative. In the apparatus being used by Mr. Stone hysteresis is practically eliminated. The coils that I have described have no hysteresis loss, and dielectric hysteresis is eliminated by using air condensers.

Such, very briefly and without detail, is Mr. Stone's system for selective wireless telegraphy. There are, however, three or four points in connection with it I wish to discuss a little further.

It may be objected that the train of waves due to a spark of the induction coil does not persist long enough to take advantage of the resonance effects. That this is not true may be proved by measuring the spark across C'' in Fig. 1 when the circuit $A^2\ L''\ A^3\ C''$ is tuned, and when its period is changed by say 20 per cent.; in this case the spark length around the condenser varied from 1¾ in. to something less than 1/32 in. We should consider, too, that while the waves in the condenser circuit, starting when the discharge takes place, commence at a maximum, gradually die out, the induced waves start-

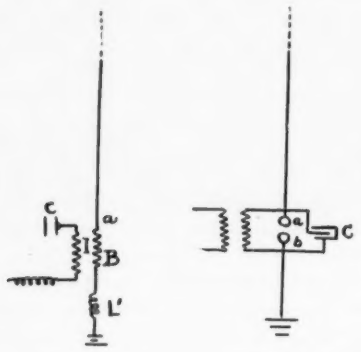


FIG. 4.

FIG. 5.

ing at a low value increase for a while, probably persist for a time and then die out slowly. It is impossible to say exactly how long the trains of waves do last, but the experiment cited above shows that they last long enough to have their full or almost their full resonant value.

I have already stated that in the Stone system the vertical sending wire is continuous, the condition of affairs being shown in Fig. 4. The typical sending wire of other systems is shown in Fig. 5, where there is a spark-gap in the circuit. This spark-gap to a certain extent limits the voltages used on account of the high ohmic resistance of a long gap—or perhaps I should say it would limit it but for the employment of large shunting condensers, which throw so much energy into the discharge that the resistance is diminished. In the Stone apparatus any desired potential difference between a and b may be obtained by changing the ratio of transformation at I, without changing the length of the spark-gap in the induction coil secondary. Again, to change the period of the waves in systems represented by Fig. 5, the geometrical constants of the system must be changed—the length of the vertical wires, for instance. In the Stone system the period may be changed without regard to the length of wire by changing the electrical constants, L and L', Fig. 4, for instance. But the most important thing is that the system with the spark-gap in the vertical wire cannot send out simple harmonic waves of one definite selected period, while the Stone system can.

I have had the opportunity of witnessing tests on the selectivity of the Stone system. There are two stations about 1,600 ft. apart in Cambridge and one in Lynn, about 12 miles from the others. The selectivity shown was about 10 per cent.; that is, a variation of 10 per cent. in the period changed the results from a maximum receptive strength to absolute zero. Trolley lines run very close—at Lynn to within 100 ft.—to the stations, but they have no effect on the receiving apparatus.

In the work that has been done on the system, coherers are used as the receptive device. A coherer is peculiarly unfitted for selective work, because of its great variations in sensibility. In changing the resonant period of the receiving device from a maximum effect a stage is soon reached where the results are uncertain—sometimes the coherer works and sometimes it does not—and this is the condition of affairs over a considerable part of the interval between maximum effect and silence. With such a system the limits of sensibility are as important as the actual sensibility.

As I have said, Mr. Stone's apparatus enables him to do two things, one of which at least must belong to any successful selective system of wireless telegraphy. First, to send out simple harmonic waves of a definite period; second, to receive these waves by an apparatus that does not respond to any other electrical disturbances.

Glasgow's Varied Activities.

It is stated that Glasgow corporation supplies the people of the second city in Great Britain with water, gas, electric light, cable and electric cars and telephones; they control 11 public parks and galleries, 13 baths and wash houses, a fruit and vegetable market, a dead meat market, a home cattle market, two foreign cattle markets, a cheese market, a bird and dog market and an old clothes market, four slaughter houses and offices, four hospitals and one burying ground; they are the owners of 2,488 municipal houses, 78 lodging houses, of which they manage 7; a family home, which they also direct; 372 shops, 49 stores, 43 warehouses, 43 workshops, 12 halls, two churches, two hotels, one theatre, one studio, one pawn office, one nursing home, one powder mill, one laundry, one bakehouse, one golf course and one gospel tent; they farm over 1,000 acres of land, where large crops are grown, including hay, oats, wheat, turnips, etc.; they convert the city sewage into solid matter and sell it to farmers for manure; they carry on business as market gardeners; they possess stone quarries and 900 railway wagons; they build street cars, reclaim bogs, conduct a civic granary, raise $5,000 a year on the clinker, from the refuse cremating furnaces, collect and sell waste paper, and are not above melting and disposing of the solder from the old tin cans they find in the dust heaps. This is interesting variety and versatility, to say the least.

Free Scientific Lectures.

Dr. Leipziger is pursuing his good work as head of the bureau of free public lectures of the New York Board of Education. Last year 1,200,000 people heard 4,221 lectures in 128 centers. He is pushing scientific lectures this year and says: "The attendance at the scientific lectures is such as to show that the purpose of the lecture course should be to lay especial stress upon the popularization of science. For this reason it is hoped that at no distant day two or three well-equipped science halls, where experiments can well be made, will form a feature of the educational plant of the city, and to those halls shall come the very ablest scientists to expound to the thinking people of our city the great principles of science, and elaborate on the great discoveries that are constantly being made."

Scientific Training.

In a very interesting lecture delivered in London recently on Lord Bacon, Mr. Sidney Lee expressed doubt whether a Temple of Science such as Bacon imagined in "The New Atlantis" would ever come into existence. At present the portents were, Mr. Lee feared, not favorable for its emergence in England. It seemed more likely to come first to birth in Germany or in America, where things of the mind received from the general public a consideration which was denied them in England. The experience of a recent visit to America had shown Mr. Lee that there was nothing in his own land to compare with the widespread eagerness among the youth of the United States to enjoy academic scientific training. It was difficult for them at home, too, to realize even dimly the munificent readiness with which American Legislatures responded to demands made on their resources to supply the American people with fit endowment and equipment of research.

Alternating Current Switchboards—V.

BY STEPHEN Q. HAYES.

(Concluded.)

EXCITER panels, although strictly coming under the head of direct-current panels, are so closely connected with alternating-current panels that it might be well to say a few words about them here. As several of the previous views have illustrated typical exciter panels, no lengthy description of them will be given. These panels are built chiefly in two styles, single-exciter panels and double-exciter panels. The former control one machine and are usually provided with a three-pole switch, an ammeter, voltmeter and rheostat. The latter control two exciters and are provided with an ammeter and rheostat for each machine, a voltmeter to be connected to either by means of receptacle and plug, two two-pole switches, one for each machine, and one single-pole switch used for the equalizer circuit.

Rotary converter panels are the connecting links between the alternating-current and direct-current panels, just as the rotaries themselves form the connecting links between the two systems. The panels for the control of the direct-current side of the rotaries and the direct-current feeders are usually standard railway panels with but slight modifications. The alternating-current panels are arranged for either two-phase or three-phase circuits and ordinarily the rotaries are arranged to be started from the alternating-current end by means of a starting motor on the end of the shaft.

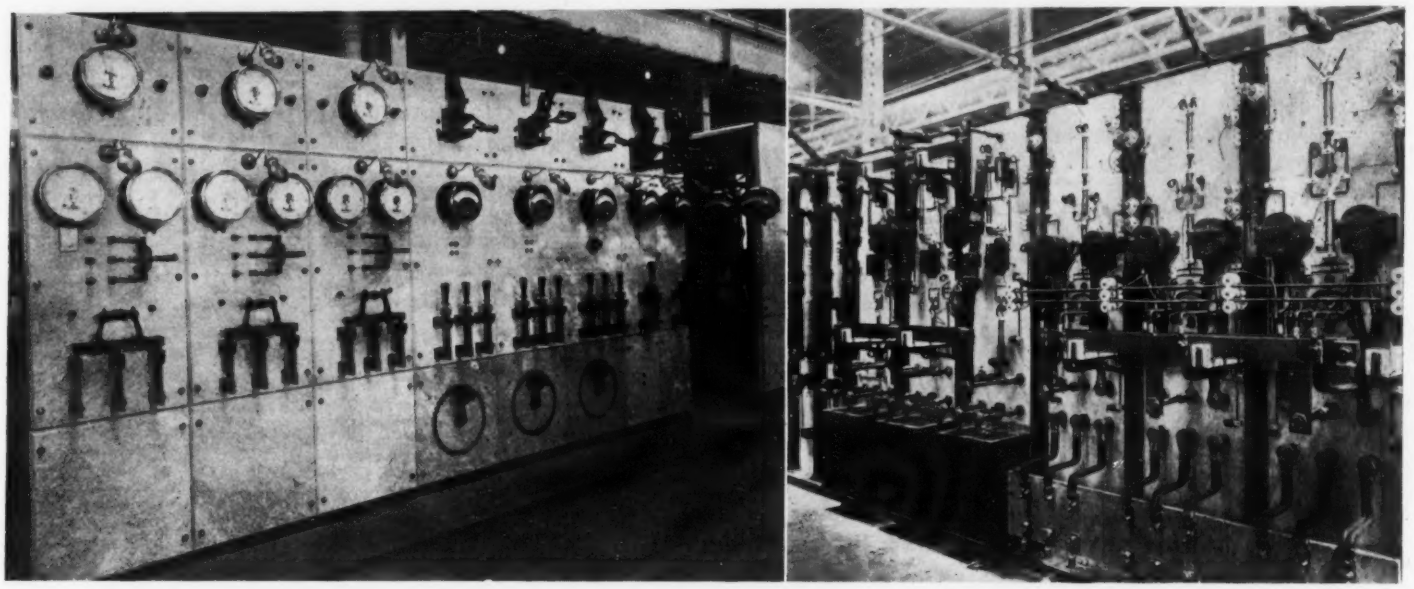
Fig. 30 shows front of a rotary switchboard supplied for the control of three 250-kw, three-phase rotary converters. The three panels at the left-hand end control the alternating-current end of the three rotaries, the next three panels take care of the direct-current end, and the last two are the direct-current feeder panels.

On the alternating-current panels the equipment consists of three ammeters, one in each phase; a three-pole, double-throw switch for the starting motor; a three-pole, single-throw main switch, and synchronizing lamps and plugs. The function of the latter switch for the starting motor is to allow either of two voltages to be impressed on the motor terminals. These motors are wound with a fewer number of poles than the rotary, so that their synchronous speed is higher than that of the rotary to which they are connected. The armature resistance of the motor is comparatively high; in fact, crane motors are used, so their speed varies with the voltage impressed on their terminals. The two voltages selected for the double-throw switches are such that one will cause the motor to run slightly above the synchronous speed of the rotary, and the other slightly below, so that by switching from one side to the other the rotary can be brought to exact synchronous speed before being thrown in.

On the board shown the lamps and plugs connected across the jaws of the main switch are used for synchronizing. Very often, however, a synchroscope is used instead, as this will indicate whether the rotary is running too fast or too slow and will show at each instant just how much out of step the rotary is at any time. As the power factor of a rotary can be varied like that of any synchronous motor, by adjusting the field circuit, some or all of the alternating-current ammeters are occasionally omitted and a power factor meter supplied instead.

A voltmeter is not considered necessary for alternating-current rotary panels, as the alternating-current voltage, as a rule, cannot be varied, and moreover bears a definite ratio to the direct-current voltage for which a voltmeter is supplied. The direct-current rotary panels are supplied with a single-pole circuit-breaker, an ammeter, a rheostat, voltmeter receptacle and three single-pole switches. The reason for furnishing three single-pole switches instead of one three-pole is that if one rotary is running and a second one is to be started up, the closing of the positive and equalizer switch on the second panel will connect the series field of the second machine in multiple with that of the first one, so that its voltage is bound to build up in the right direction. Swung on the end of the board are two direct-current voltmeters, one connected to the direct-current bus-bars and the second connecting through a voltmeter bus and the voltmeter receptacles with any of the three rotaries. The last two panels are direct-current feeder panels, each provided with a circuit-breaker, ammeter and switch, with a lightning arrester mounted on the rear.

Fig. 31 shows the rear of this same board and illustrates one method of mounting fuses in gangs on the rear of a switchboard. In the stations of the plant where this board was installed the alternating-current sides of the rotaries were connected to a common set of bus-bars fed from a bank of lowering transformers, and for this reason it was necessary to insert the fuses. Where each rotary is fed from its own bank of transformers, the low-tension fuses are omitted, the automatic protection being furnished by fused circuit-breakers or similar apparatus in the high-tension side of the lowering transformers.



FIGS. 30 AND 31.—FRONT AND REAR VIEWS OF ROTARY CONVERTER SWITCHBOARD.

In connection with rotary converter boards, it might be well to call attention to the necessity of field switches when the rotary is started from the direct-current side by means of a starting rheostat. When starting, the field of the rotary must be connected to the direct-current bus and when the rotary is up to speed the field should be connected to the brushes of the rotary. For this work a double-throw rocker type switch has been designed to transfer the field from the bus to the rotary without the field being opened.

When a rotary is operated from direct to alternating-current, it will not work satisfactorily with its field connected to its own armature or to any source of constant direct-current e.m.f. The reason for this is that if a heavy current is taken off from the alternating-current end, particularly if the power factor is low, the armature reaction will weaken the field and the rotary, behaving like a shunt motor with its armature voltage kept constant and field weakened, will speed up, changing its frequency, etc. To obviate this very objectionable change in speed, inverted rotaries may be excited from specially designed shunt-wound exciters attached

to the end of the shaft, or driven in synchronism with the rotary; as the exciter is operated with an unsaturated field a slight change is its speed will mean a big change in its voltage. This change in the exciter voltage will so strengthen the field of the rotary as to hold its speed practically constant.

The additional apparatus needed for an inverted rotary consists simply of the exciter rheostat, a field switch and occasionally a direct-current differential voltmeter with one side connected to the terminals of the field and the other connected to the exciter. As the rotary has to be started up with its field connected to the direct-current bus-bars, this differential voltmeter indicates the correct instant for transferring the field from the bus to the exciter. A special switch does this without opening the field circuit.

Rotary converters are often used to feed three-wire, direct-current circuits, the neutral connection being brought out from the lowering transformers feeding the rotary. The alternating-current panels for three-wire rotaries are the same as for the two-wire, but the direct-current panels differ from standard railway panels in that they have two single-pole circuit-breakers, two ammeters and three single-pole switches, instead of one ammeter, one single-pole circuit-breaker and three switches. The reason for this difference is that on three-wire machines it is necessary to have an ammeter and circuit-breaker in both the positive and negative circuits, as the current in the neutral may be due to an unbalancing on either side, so a meter in one wire would not properly indicate the load on the machine, nor would a breaker in one leg give sufficient protection.

The Westinghouse Company is at present building a great many switchboards using oil switches mounted either on the panels or apart from the board and operated mechanically or electrically, but as these are usually designed to meet special conditions, they hardly come under the same class as the "standard" panels described in these articles, so no mention has been made.

Measurements of Radioactivity.

In newspaper references to the gift of radium recently made to the New York Museum of Natural History by Mr. E. D. Adams, the activity of the material was expressed in numbers with no explanation of the manner in which the numbers were determined. In the paper read by Mr. Hammer in April before the American Institute of Electrical Engineers and the American Electrochemical Society, which in part treated of radium, this explanation appears.

To measure radioactivity, Prof. and Mme. Curie measure the electric conductivity which a radioactive substance imparts to air, and take as unit the radioactivity of uranium. The radioactive substance is placed on one of two condenser plates, which are charged to a high potential. The air between the condenser plates is rendered a conductor of electricity by the presence of the radioactive substance, and in a certain time a certain quantity of electricity will pass from this condenser plate to the other plate. This quantity of electricity passing over in a certain time is determined and serves as a measurement of radioactivity. If the quantity of electricity passing from one plate to the other in a certain time is x times the quantity which would pass in the same time if uranium was substituted for the tested radioactive substance, it is said that the latter has the radioactivity x. The problem is, therefore, to measure the quantity of electricity passing from the one condenser plate to the other in a certain time. This may be done in two essentially different ways. Either by an electrometer method the quantity of electricity may be measured which during a given time passes over to the previously uncharged condenser plate. Or the time may be measured in which this plate when connected to an original charged gold leaf electroscope discharges it. For these latter measurements the gold leaf electroscope may be observed by means of a telescope provided with a micrometer scale and the time taken for the discharge of the electroscope is taken by the means of a chronometer. By such methods, the Curies say, according to Mr. Hammer, that they can detect the presence of a radioactive substance by the means of such a minute quantity that it would require 5,000 times this amount to show at all in the spectroscope. And it is stated that this method of electrical analysis is thousands of times more sensitive than spectrum analysis and millions of times more sensitive than chemical analysis.

Photometric Tests of the Nernst Lamp.

The fourth progress report of the N. E. L. A. Committee for Investigating the Photometric Values of Arc Lamps is devoted to the Nernst lamp, and to tests of the mantle and naked gas flame. The work has been carried on, as heretofore, at Purdue University, by Prof. C. P. Mathews, assisted by Messrs. Paul G. Winter and Terry T. King. Prof. W. E. Goldsborough is the chairman of this committee.

A careful series of tests was conducted upon the Nernst lamp of the one, three and six-glower types, equipped with the various globes, shades and heater cases furnished by the manufacturers. In making candle-power measurements on the Nernst lamp, constancy of voltage is of the utmost importance. A special test given in the report shows that a change of 1 per cent. in the voltage makes in this particular case a change of more than 14 per cent. in candle-power. It was found that operation of the Nernst lamp under conditions of a constant current of .4 amp. per glower, gives the most satisfactory result from a photometric standpoint.

Fig. 1 shows the distribution of candle-power from a six-glower lamp in a horizontal plane containing the glowers. It will be seen that the candle-power in this plane varies between wide limits. Normal to the glowers the value is 260 per cent. of that parallel to the glowers. This horizontal distribution of candle-power is char-

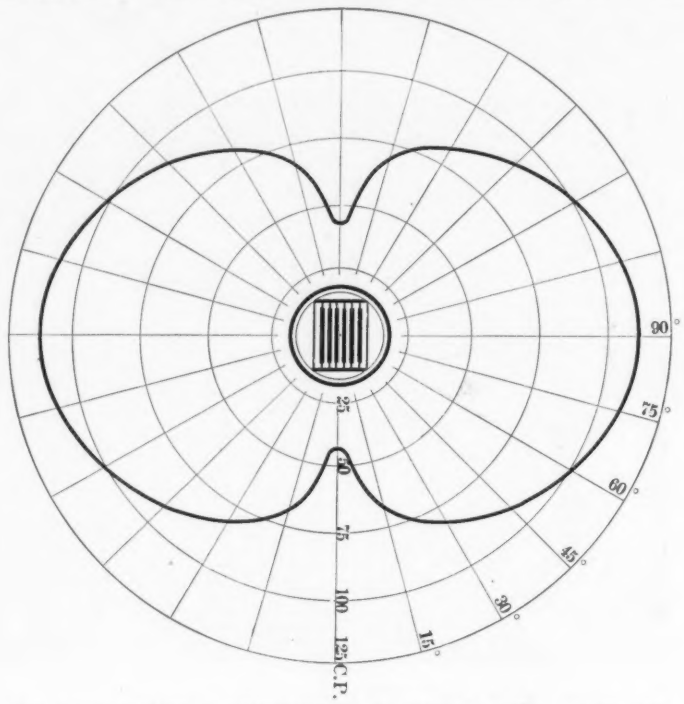


FIG. 1.—HORIZONTAL DISTRIBUTION OF CANDLE-POWER ABOUT SIX-GLOWER LAMP, EQUIPPED WITH CLEAR GLOBE.

acteristic of the parallel arrangement of glowers in a horizontal plane. It is interesting to contrast this curve with similar curves obtained from the naked gas flame, the mantel burner, and the arc lamp. These last-named sources give candle-power distributions in the horizontal plane that are circular, or nearly so. When the Nernst lamp is equipped with a diffusing globe, its horizontal distribution of candle-power is, of course, considerably rounded out. Because of this peculiar distribution of candle-power, the computation of the mean spherical intensity presents some difficulties not found in the case of the other sources referred to. The difficulties are, in fact, precisely those encountered in spherical measurements on an incandescent lamp. In Table I the relative errors in the three different methods of computing the mean spherical intensity from candle-power distribution are shown. The methods are: (1) From the mean of six distribution curves in vertical planes 15° apart. (2) From the mean of two distribution curves, namely, parallel and normal to the glowers. (3) From a single distribution curve in a vertical plane 35° to the glowers.

Considering the first method as correct, the errors in the other two methods are as tabulated. The second method seems to yield a result correct to about 1 per cent., when diffusing globes are used, and about 4 per cent. when clear globes are used. It was found that there is no single plane, in which a candle-power distribution can be

taken and integrated for the mean spherical intensity, with correct results for all types of globes and shades. With an integrating photometer, however, the matter becomes simply that of the taking five or six photometer settings, the mean of which yields the value sought.

From the records of the many Nernst lamp tests, contained in the report, those on a six-glower lamp equipped with various globes and shades, are reproduced here as being fairly typical. Figs. 2 and 3 show the distribution of candle-power from this lamp in vertical planes respectively parallel and normal to the glowers.

TABLE I.

ERRORS IN COMPUTATION OF MEAN SPHERICAL AND MEAN HEMISPHERICAL CANDLE-POWER.

Lamp.	Mean of six curves every 15° around glowers.	Mean of parallel and normal.	35° to glowers.
	Per cent. error.		
Six-glower, clear globe, M. H. S.....	0	—4.3	
Six-glower, clear globe, M. S.	0	—4	
Six-glower, pearl opal globe, M. H. S.	0	+ .8	—2
Six-glower, pearl opal globe, M. S.	0	+1.8	—1
Three-glower, pearl opal globe, M. H. S. ..	0	+ .5	
Three-glower, pearl opal globe, M. S.	0	+ .9	

Figs. 4 and 5 show candle-power distribution in the same planes from the same lamp when equipped with opal and metal shades. The results show that the Nernst lamp equipped as indicated gives maximum candle-power directly beneath the lamp. It may be said that for many purposes this distribution of light is very satisfactory, there being sufficient upward light for the purpose of general illumination, while the light thrown downward within an angle of 45° from the vertical is very strong, making a desirable source for the illumination of reading tables, counters, machines, etc. A comparison of Figs. 2 and 3 brings out the great difference in the distribution of candle-power in the two vertical planes respectively parallel and normal to the glowers, to which reference has already been made. The use of opal and sand-blasted globes alters the distribution of candle-power in such a way as to diminish the downward intensities and increase the outward and upward intensities.

The marked effect of various shades and globes on the downward flux of light is well illustrated in the case of the tests upon the three-glower Nernst lamp. As tested with a constant current of .4 amp. per glower, this lamp consumes approximately 260 watts. It yields mean hemispherical candle-power ranging from 64.3 for the pearl opal ball, to 118.4 for the clear heater case. The corresponding values of watts per mean hemispherical candle-power, is 4.18 and 2.22.

The wide variation in these values indicates clearly how it is possible to alter the flux of light below the horizontal plane by the use of different globes and shades, and is a strong argument against

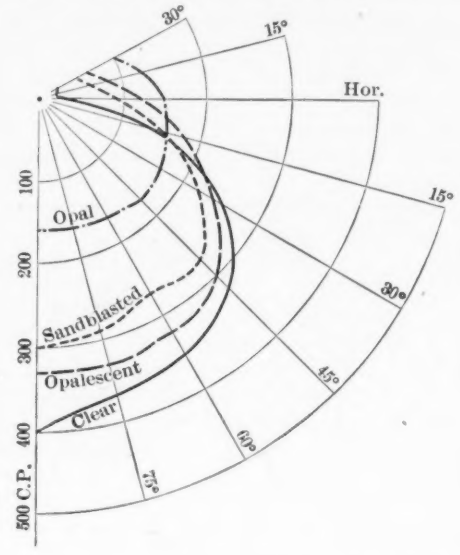


FIG. 2.—DISTRIBUTION OF CANDLE-POWER IN A PLANE PARALLEL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH GLOBES AS INDICATED.

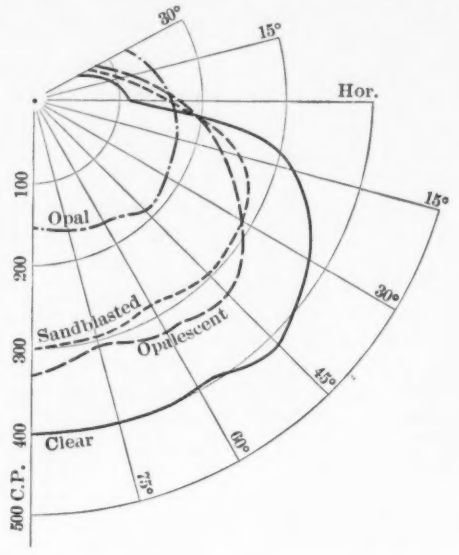


FIG. 3.—DISTRIBUTION OF CANDLE-POWER IN A PLANE NORMAL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH GLOBES AS INDICATED.

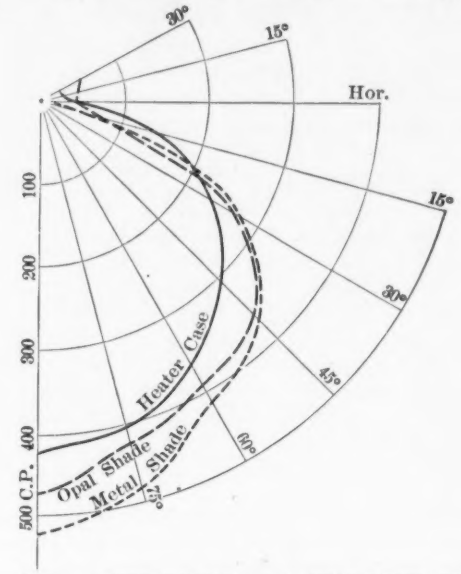


FIG. 4.—DISTRIBUTION OF CANDLE-POWER IN A PLANE PARALLEL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH CLEAR HEATER CASE AND OPAL AND METAL SHADE AS INDICATED.

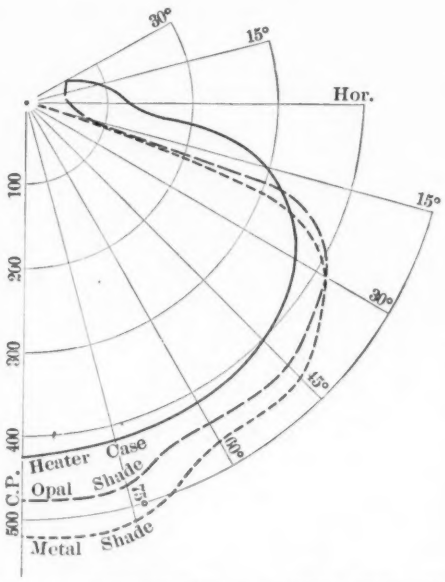


FIG. 5.—DISTRIBUTION OF CANDLE-POWER IN A PLANE NORMAL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH CLEAR HEATER CASE AND OPAL AND METAL SHADES AS INDICATED.

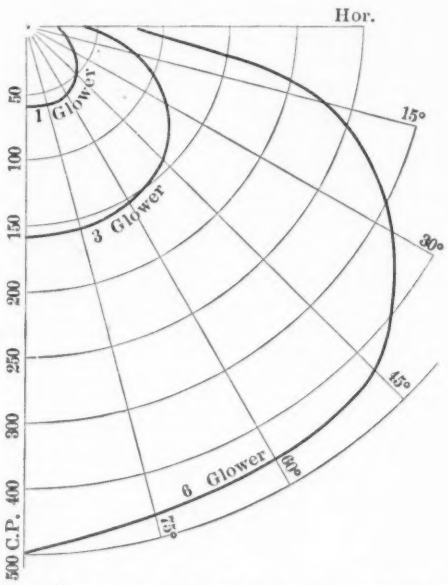


FIG. 6.—MEAN DISTRIBUTION CURVES EQUIPPED WITH CLEAR GLOBES.

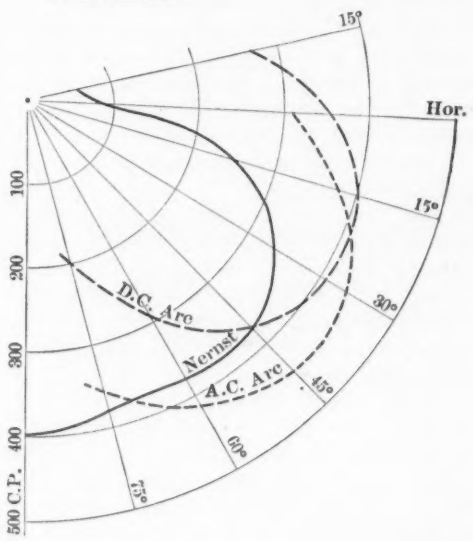


FIG. 7.—COMPARATIVE DISTRIBUTION CURVES OF NERNST AND ARC LAMPS.

the rating of lamps on the basis of mean hemispherical candle-power, or, for that matter, on any basis that does not take into account the total volume of light emitted by the source. Coming now to a comparison of the light output, based on the mean spherical candle-power, we find a minimum of 51.9 and a maximum of 68.7, the power consumption being the same as in the previous case. The corresponding variation in specific power consumption or watts per mean spherical candle-power, is from 5.09 to 3.84. It is evident that the variation in mean spherical candle-power can be due only to differences in the absorbing power of the globes and shades used. To put the matter in another way, this three-glower lamp, consuming approximately a constant power, is made to yield through the agency of its nine different equipments, a maximum variation of 84 per cent. in mean hemispherical candle-power, and a maximum variation of 32 per cent. in mean spherical candle-power.

It is interesting to note the relative candle-power of the one, three and six-glower lamps. In Fig. 6 will be found distribution curves plotted to the same scale for the three lamps, equipped with clear globes. These curves are the mean of parallel and normal distributions.

The relative power consumption per unit of candle-power is shown in Table II, which gives the watts per mean hemispherical and per mean spherical candle-power for each of the three types of lamp.

TABLE II.

RELATIVE POWER CONSUMPTION PER CANDLE-POWER OF ONE, THREE AND SIX-GLOWER LAMPS WITH VARIOUS GLOBES AND HEATER CASES.

Watts per Mean Hemispherical Candle-power.

No. glowers.	Opal heater case.	Clear heater case.	Clear globe.	Opal globe.	Sand-blasted globes.
1			2.31	4.19	2.78
3	3.09	2.22	2.33	4.18	2.72
6	2.31	1.90	1.88	3.25	2.29

Watts per Mean Spherical Candle-power.

No. glowers.	Opal heater case	Clear heater case.	Clear globe.	Opal globe.	Sand-blasted globes.
1			4.11	4.95	4.30
3	4.55		4.04	4.51	4.28
6			3.30	4.01	3.64

The table shows clearly that the three-glower lamp is slightly more efficient than the single-glower lamp, and the six-glower lamp considerably more efficient than the three-glower. This increase in efficiency can be accounted for, if we remember that a number of glowers in close proximity must, through mutual radiation, operate at higher temperature than would an isolated glower. The result is an increase in light output in spite of the fact that multiple glowers must screen the light from one another in certain directions, dependent upon their arrangement in the holder. Thus, if the number of glowers be increased, in the type of lamp with which we are dealing in these tests, the horizontal intensity will not increase in the same ratio as the downward intensity, because of the screening action of one glower upon another.

The report contains interesting results on the effect of varying the number and arrangement of glowers in the holder. The whole matter may be summed up by saying that, increasing the number of glowers, augments the efficiency of the lamp in candle-power per watt, notwithstanding the screening action of the glowers one upon another.

TABLE III.

Angle.	Candle-power. Nernst 6 glower.	Series arc A. C.	Series arc D. C.
Hor.	87	310	352
15° B.	248	375	404
30° B.	335	440	410
45° B.	373	445	375
60° B.	372	420	295
75° B	380	355	200

Globes.	Clear.	Opalescent inner, street shade.	Opalescent inner, clear outer.
E. M. F.	226	73.8	71.
Current	2.4	7.5	6.6
Watts	542	469	459
Mean hemispherical candle-power	289	394	360
Watts per mean H. S. C. P.	1.87	1.19	1.27

Although the six-glower Nernst lamp takes about 20 per cent. more power than either the direct or alternate-current, series-arc lamps commonly used in street service, yet it is, as regards maximum candle-power, a light source of the same order of brightness, and hence a comparison of the three sources is justifiable. Fig. 7 shows the mean distribution curve of the six-glower Nernst lamp, equipped with metal shade, plotted on the same sheet with the curves for the 6.6-amp., direct-current, series-arc and the 7.5-amp., alternating-current, series-arc. (See Table III.) These arc curves have been taken from a previous report of the committee. The lamps on which these measurements were made were equipped for street service. The direct-current lamp having an opalescent inner globe and a clear outer globe, the alternating-current lamp having an opalescent inner globe and a metal shade. It will be noted that the candle-power distribution of the Nernst lamp is altogether different from that of either arc lamp. The Nernst lamp is strong where the arc lamps are weak, and vice versa. The points of intersection of the curves form segments which show the superiority in certain zones of each lamp over the other two.

New York Meeting of the American Institute of Mining Engineers.

THE eighty-fifth meeting of the American Institute of Mining Engineers was held in New York City from October 13 to 17. At the opening meeting on October 13, biographical notices of lately-deceased members were presented as follows: J. P. Leslie, by Mr. Benjamin Smith Lyman; William E. Dodge, by Dr. James Douglas; Theodore D. Rand, by Dr. T. M. Drown, and George S. Morison, by Dr. Leonard Waldo. The sessions devoted to the reading and discussion of papers were held on October 14 in Columbia University and on October 15 in the Hall of the American Society of Mechanical Engineers. The papers read on the first day referred to mining and to the science and art of metals other than iron and steel, while the session of the second day was devoted to the metallurgy of iron and steel.

On the afternoon of October 15 optional trips to metallurgical plants in the vicinity of New York had been arranged, invitations having been extended to the Institute by the following concerns: The American Smelting & Refining Company, the Nichols Chemical Company, the Balbach Smelting & Refining Company, and the Bayonne Refinery of the Standard Oil Company. On the evening of October 15 a reception and dance were given at Sherrys. On October 16 an inspection of the Rapid Transit Subway had been arranged for the forenoon and for the afternoon a trip by water around Manhattan Island. On the evening of the same day Dr. G. F. Kunz and Dr. Charles Baskerville presented a paper on "the action of radium, Röntgen rays and ultra-violet light upon minerals" at the hall of the American Museum of Natural History. On October 17 a visit was made to West Point and to the football game between Harvard and West Point.

During the session of Thursday the secretary, Dr. R. W. Raymond announced the result of balloting concerning the proposed gift of Mr. Carnegie, "a fellow member of the American Institute of Mining Engineers," for the Union Engineering Building. It will be remembered that the council had declared heartily in favor of this scheme and that the question of the advisability of the Institute of Mining Engineers joining the other societies in this scheme was submitted to all the members for a letter ballot. Out of about 3,500 members, 1,600 voted, and Dr. Raymond stated "about 1,600 votes were in the affirmative and 5 or 6 voted against it." The argument presented by the latter was that the society had been run so smoothly for so many years that it seemed not advisable to change anything. Dr. Raymond pointed out that this smooth running of the affairs of the society was mainly due to two principles which were always followed. First that the council of the Institute is omnipotent; second, that this omnipotence refers only to a very limited circle of duties. Neither the council nor even the society itself is allowed to adopt resolutions for or against, say, the metric system or to adopt rules of standardization. This does not prevent the Institute from having a committee appointed for a discussion of such questions or to discuss it in a general session; but what the Institute is after is the information gathered by such committees or brought out in such discussions, and not the adoption of resolu-

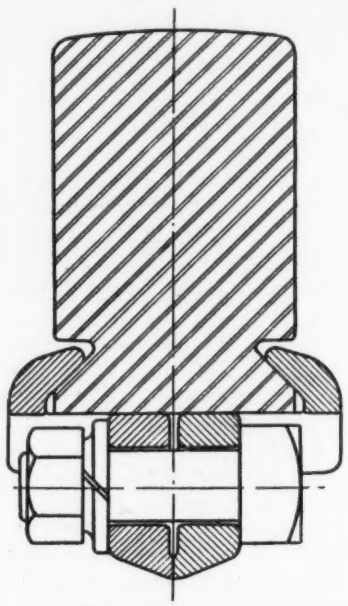
tions. "We do not endorse anybody's theory, we do not endorse our own." The carrying out of the Union Engineering Building scheme will necessitate some changes in the constitution of the Institute of Mining Engineers. They will be submitted to the members at the next general meeting in February, 1904. One of these changes refers to the introduction of an initiation fee for members, the other one to the formation of a separate corporation, a board of trustees, which will have in charge the ownership of the Union Engineering Building, as far as the Institute of Mining Engineers is concerned.

In the whole 50 papers were on the programme of which, however, only a small number were read. Below we give an abstract of those which are of interest to electrical engineers.

TESTS OF STEEL FOR ELECTRIC CONDUCTIVITY, WITH SPECIAL REFERENCE TO CONDUCTOR RAILS.

A paper on this subject was presented by Mr. J. A. Capp, of the General Electric Company, of Schenectady, N. Y. He started with a brief comparison of the trolley system and the third-rail system. While no third-rail installation has yet been in operation long enough to give exact figures of cost, it would appear that the cost of maintenance of the third-rail construction should be less than that of the overhead trolley. This consideration, together with that of sightliness and adaptability (especially in the case of terminals, yards and very heavy or high-speed service) would frequently offset a higher cost of the third-rail construction.

For the first third-rail installations old rails were used when obtainable, and these old rails were supplemented with new rails of standard T-section and composition. With the coming of the very heavy high-speed service during the past few years, the resistance of these old and new standard T-rails was found to be so high that they would not carry the high currents necessary, without too great a drop in the line potential.



CROSS-SECTION OF NEW CONDUCTOR RAIL.

"Because of the lack of specific data on the relation between conductivity and composition of mild steel, specifications for conductor rails have usually been based on the fact that the conductivity of a metal is generally more or less directly in proportion to its purity. In most cases the purity of the iron specified for such rails has been so high that not only was it difficult to obtain, but the iron was also correspondingly of high price. One of the factors governing the choice between a third rail and a trolley wire is the relative price of steel and copper, allowance being made for the difference in conductivity. Hence, a balance must be struck between high conductivity (which is equivalent to saying a high degree of purity or freedom from the usual metalloids associated with iron) and the cost of producing the steel of the composition necessary for the conductivity required."

The author then gave the results of tests made in the testing laboratories of the General Electric Company with the object of drafting an original specification for such third-rail steels. Steels of as wide a range of composition were tested as could be obtained from the steel makers and the results are given in various tables and diagrams.

The T-section rail was the outcome of designs intended to present the greatest life and strength of the section, with the least weight of the metal, conditions necessarily to be met in a running rail. But the conditions of the third rail are different. What is required here is sufficient surface for the collection of the powerful current, and an ample cross-section to carry the current without an undue drop in potential. On the other hand, the strength of the section is of little moment, and any section which is easily installed in an insulator is satisfactory. This permits the use of sections rectangular or nearly so which may be rolled easily in many mills. With these facts in mind a section of a conductor rail has been designed by Mr. W. B. Potter which, when 2.5 in. wide by 4 in. high, will weigh about 98 pounds to the yard. This shape, which is shown in the attached diagram, may be easily rolled in any merchant bar mill heavy enough to attempt sections of this weight. A dove-tail at the bottom provides an easy means of securing the rails by fishplates of special forms, and any of the common forms of bond may easily be applied. Ordered in lots of a thousand tons or more, such a rail should cost no more than a plain rectangle of equal weight.

From the elaborate tests of the author on the influence of special additions to steel upon its electric conductivity it appears that manganese preponderates in influencing the resistance of the steel, and that for lowest resistance manganese must be present in very small quantity, much smaller than is usual in merchant steel or structural steel. While all the elements must be present only in very small percentages, so great is the preponderance in the influence of manganese that other elements may be tolerated in quantities which the steel makers would consider reasonable, without unduly increasing the resistance.

For a satisfactory third rail, the lowest possible resistance (say, from 6 to 6.5 times that of copper) is not necessary; and the great cost of making such extremely pure steel is not warranted. In fact, such extremely pure steels would probably be so soft that the frictional wear of the collecting shoe would be excessive and the life of the rail in service unduly short. Assuming, then, that a rail made from steel having a resistance not greater than eight times that of copper (13.8 microhms at 20° C.) would be desirable for conductor rails, the figures tabulated would seem to indicate that the following extreme composition would be permissible:

	Per cent.
Carbon up to	0.2
Manganese up to	0.4
Phosphorus up to	0.06
Sulphur up to	0.06
Silicon up to	0.05

This composition, however, would be extreme, and any overstepping of bounds might result in too great resistance; therefore, for resistance up to eight times that of copper, the specified analysis should be:

	Per cent.
Carbon not to exceed	0.15
Manganese not to exceed	0.30
Phosphorus not to exceed	0.06
Sulphur not to exceed	0.06
Silicon not to exceed	0.05

This latter composition is one which could be made easily in any open-hearth furnace, and it should present no difficulty in rolling to a shape suitable for conductor rails. In fact, steel of this composition has been successfully rolled into sheets as thin as 0.014 in., a size which was for a long time a standard product of a large sheet mill.

The author added some remarks concerning wear and tear of such conductor rails, and from what he said it appears that this is a very serious question. While he did not give the exact figures, he said that the wear and tear of the third rail of the Manhattan Railroad has been about 1/10 of an inch since the time of its installation. This seems to be too much.

In the discussion which followed, Dr. Raymond asked why wheels are not used instead of the ordinary shoe for collecting the current from the third rail. Mr. Capp replied that the shoe gives a much better line of contact. The shoe, as made at present, does not wear, while the rail does. In the further discussion, in which Mr. John Fritz and Mr. Herbert E. Field and others participated, the fact was brought out that any larger addition of nickel to steel would increase the electric resistance enormously. On the other hand, it is possible that a small addition of nickel might diminish the wear and tear to an extent which might more than counterbalance the increase of resistance. However, from the general drift

of the discussion, it was evident that the problem is still to be considered as unsolved.

ELECTRIC STEEL FURNACE AT GYSINGE, SWEDEN.

A paper on this subject was presented to the Institute by Mr. F. A. Kjellin, of Gysinge, Sweden. In the absence of the author, the paper was read by Dr. Leonard Waldo, who, in his introductory remarks, called attention to the very high temperature of the electric arc, which is much higher than the temperature required in the metallurgy of iron and steel. He, therefore, thinks that the arc furnace is not specially suitable for iron and steel. "Boiling iron is very interesting, but not of much use." The resistance furnace is a good substitute, but the trouble with the ordinary resistance furnace, if used for iron and steel, is that the electrodes are eaten up and that the charge is thus contaminated from the electrodes.

This difficulty is completely overcome in the "induction furnace," in which the charge represents the single secondary turn of an alternating-current transformer. There are, therefore, no electrodes whatever. The operator is in absolute control of the situation, and especially of the temperature. There is absolute freedom of the charge from contact with any form of fuel.

Dr. Waldo then read Mr. Kjellin's paper in which he describes his interesting induction plant, which was also described in ELECTRICAL WORLD AND ENGINEER of April 4, 1903. Mr. Kjellin, who had first made experiments with a small furnace of this kind, had the misfortune that a pulp mill which he owned burned down. He then concluded to use the available water power for a larger steel furnace. Mr. Kjellin's paper does not seem to contain much more information concerning his plant and his process than has already been published in these columns. He emphasizes that the steel which he makes is of the very best kind. It contains no gaseous matter. It is very easy to make the composition of the steel just what it is wanted to be. There was no discussion of the paper.

COMPRESSED AIR AND ELECTRICITY IN MINING OPERATIONS.

Advanced sheets were available of a paper by Mr. W. L. Saunders, who discussed and criticised some points of a paper of Mr. W. B. Clarke on electrical apparatus for coal mining. Mr. Saunders says in the beginning of his paper that there is no war between electricity and compressed air. Each one has its field of usefulness, and in that field each is supreme, but the general tendency of Mr. Saunders' paper is to show that compressed air is preferable for certain purposes.

"At least ten years ago, our engineering papers contained large advertisements and pages of reading matter about the application of electricity to mines, recording the introduction of numerous rock-drilling plants, and claiming that the problem had been solved, greatly to the advantage of the miner, and with promise of large profits to the manufacturers of electrical apparatus. Edison and Elihu Thomson labored to apply electricity to mines, and each believed that the probabilities of success were great. This was the period of the solenoid rock drill, which was admirably suited, theoretically, to the percussive principle, and in the development of which hundreds of thousands of dollars have been spent without satisfactory result. I have searched in vain for a standard mining equipment where electric rock drills are in constant commercial operation."

Mr. Saunders quotes several authors and points out that there is no place where the pneumatic engineer has an easier time when competing for the introduction of machinery than in a coal mine for the reason that air is exactly what is wanted in such a mine and electricity is what is not wanted, the one being safe and healthful, the other dangerous and destructive. Mr. Saunders says that there are places where electricity is particularly well adapted for mine haulage, and where it is to be preferred possibly to any other means, but that those places do not exist everywhere, and that it would be wrong to put down broad principles. He also holds that unless some one discovers a better way to drill rock than by the hammer blow it is likely that the air drill will stand supreme for many years to come. "No electric drill that has thus far been devised has equaled it in simplicity, and it is certain that no electric drill has ever equalled it in drilling capacity, which is really the measure of efficiency."

Alaska Cable.

Advices from Alaska state that the Signal Corps cable from Sitka to Juneau went into regular operation on October 3, and is now being worked in conjunction with the Skagway cable. General Greely, head of the Corps, has been superintending the operations in person.

The Electric Tramways of Kalgoorlie, Western Australia.

BY S. W. CHILDS.

In many respects, the continent of Australia offers opportunities for the investment of American capital, energy and brains unsurpassed by few other countries in the world. This is particularly true of the colony of Western Australia, occupying the western portion of the Island Continent. This section comprises an area of nearly 1,000,000 square miles, much of which is yet undeveloped, but which has large mining, agricultural and industrial possibilities. A description of the Kalgoorlie electric tramways will suffice to show, as a single instance, what has been and what can be accomplished in the transportation line alone there. Although the city is situated 400 miles inland from Perth, the nearest seacoast town, it now enjoys the facilities of an electric trolley system, built and operated according to the latest American practice, and not surpassed as far as engineering features are concerned, by any city of similar size in the Old or New World. Incidentally, a statement of some of the difficulties encountered in building the system may be of interest.

Kalgoorlie has a population of about 30,000 people, and the tramway lines were laid out to furnish transportation within the city itself, and to the gold fields lying in the outskirts of the city. The heaviest business handled by the tramway comes from the miners, who flock to the city in large crowds, particularly on Saturdays and Sundays. The tramway system comprises 16 miles of track, of which 10 miles are double-track and 6 miles are single-track lines. The fares are collected on the "flat" system; that is, the fare is 3 pence, or 6 cents for a ride within the municipal boundaries, and 6 pence, or 12 cents, to any point outside the city or into the Roadsboard district, as the suburbs are called. Cash fares are collected and registered as in the United States.

The tracks are laid in a soil which is practically a good natural cement of ironstone composition, which, though hard to work, forms a very good and permanent roadbed. In some cases, excavations for track were made by native laborers with pick and shovel, and in some cases with horse-drawn plows. The rail is a 90-pound girder, supplied partly by a Belgian house and partly by the Lorain Steel Company, of America. For ballast and road making, residue from the gold mines known as "blue metal" was used to good advantage. This is harder than granite and, when broken into sizes ranging from 1½ to 2½ in. in diameter and laid to a depth of 6 in. under the ties, forms a very hard and firm, yet elastic, roadbed. The rails are laid on ties of "jarrah" wood, a native wood as hard and fine as American mahogany. It is practically indestructible, proof against the attacks of the white ants, and impervious to moisture. It is now being used with great success as block paving in the streets of London. The ties are 6 x 8 in. x 7 ft. 6 in. foot laid —2 ft. between centers. The rails are joined with six-bolt fishplates with tie rods every 6 ft. The track is bonded with Mayer & Englund double bonds under the fishplates. It is interesting to know that during the track excavation work, gold nuggets were frequently turned to the surface by the plow—unfortunately, however, not in paying quantities. For double-track lines, the double-bracket style of overhead construction was employed with a single line of 35-ft. poles of jarrah wood between the tracks. The overhead brackets were also supplied from Philadelphia. On single-track lines single-bracket construction was used.

The car house measures 300 x 60 ft. It is built of steel throughout covered with galvanized iron. The steel for the building was furnished by the American Bridge Company. The pit arrangement at the car house is novel and is applicable to American conditions. The track rails upon which the cars rest in the car house are carried on cast-iron columns 5 in. in diameter, resting upon concrete cement piers. There is no flooring, strictly speaking, in the car barn, but all the work is done from the ground level. To expedite repair work, a bogie truck with flat-tired wheels is used, which can be moved about at will over the ground level. At the back of the barn on the lower level is a set of cross tracks so that armatures and truck and motor parts can be dropped to this level and taken under the cars to any part of the workshops on the bogie trucks. The workmen stand on the bogies when doing the truck and motor repair work.

Owing to the scarcity of fresh water in this locality, there have been constructed at the car barn two concrete cement tanks running the full width of the building, into which is drained all the rain water falling upon the roof. These tanks are 60 ft. long, 8 ft. deep

and 5 ft. wide, and each year they catch and render available about $5,000 worth of water, which is used for washing the cars and for fire protection purposes. The car house is equipped with a complete system of automatic sprinklers in the roof, the water for the sprinkling system being drawn from the cement storage tanks by a pump and forced to an elevated tank near the car house by which means adequate pressure is maintained on the sprinkling system.

The company owns 10 double-truck cars and 15 single-truck cars, all of which are of the closed type and were furnished by the Brill Company, of Philadelphia. The cars are mounted on Brill trucks and in the case of the single-truck bodies they are equipped with two General Electric motors. The double-truck cars have four General Electric motors to each car, following accepted American practice.

Power is furnished by the Kalgoorlie Electric Power and Lighting Corporation, Limited, which also supplies electric power to the neighboring gold mines. This plant is capable of producing power economically, using during dry seasons water which is practically a saturated solution of ordinary and other salts. The entire plant was designed by J. G. White & Co., Limited, of London, which later secured the contract for its complete construction, and built a plant which is generally recognized as being unusually well done. The power house contains three vertical units, each consisting of an 800-hp engine made by D. Stewart & Co., of London and Glasgow, and direct-connected to a 500-kw General Electric alternator. These units supply two cycle alternating current at 600 volts, which for tramway purposes is changed to 550 direct current in two General Electric rotary converters, located at the power house. Steam is furnished by a battery of Babcock & Wilcox boilers using "Australian gum" wood as fuel. Up to a short time ago practically the only water available for power house purposes was a brackish liquid obtained from the low levels of the mines, and to fit this for boiler purposes it was necessary to maintain large evaporating and condensing plants. Lately, however, the Kalgoorlie water system has been completed, which is now pumping fresh river water from the coast 400 miles away.

The Kalgoorlie Electric Tramways, of which the writer was general manager, are owned by a London syndicate, but were built by J. G. White & Co. The tramways were opened to the public on May 20, 1902, and on the opening day souvenir tickets were sold for 50 cents each, at which price over 10,000 tickets were sold to people who were anxious to commemorate the event by riding on the opening day.

One of the difficulties in the way of economical operation is the climate, which is very dry for nine months in the year. These conditions giving rise to severe dust storms, the dust in the air at times becoming as thick as the proverbial London fog. Hence, it is difficult to maintain the exterior and interior finish of the cars in good shape, and the dust also hinders operation by filling in the groove of the rail. The only way of freeing the groove from this accumulation of dust is to force it out by a stream of water, fed under pressure to a nozzle attached to the sprinkling cars. As before stated, the water contains a large percentage of salt, and this is not conducive to long life of rails or motor equipments. The top soil is also saline and very detrimental to the rails.

Although the cost of building these tramways was very high, due to the transportation and tariff charges, it is interesting to know that the road was built at a cost of $5,000 per mile less than the original estimate. The cost of living in Australia is high, and labor is able to demand high wages. Ordinary laborers on the track receive 30 cents an hour and conductors and motormen are paid $3 per day, of eight hours.

China Objects to Wireless Telegraphy.

According to a dispatch from Pekin, the first wireless telegraph station of Marconi on the coast of China was opened October 17 in the presence of the Diplomatic and Military Corps and representatives of the Board of War and the Board of Foreign Affairs. Congratulatory messages were exchanged with the Italian flagship *Vettor Pisani*, which was lying off Taku. Wireless telegraphy, as an auxiliary defence for the legations was first suggested as a mutual plan between the legations, but to Italy is due the credit for the realization of the scheme. It is reported that the Chinese Government has already offered worship to heaven to confound the electrical spirits.

Methods and Means of Extending New Central Station Business.

At the meeting last week of the Ohio Electric Light Association, Mr. M. C. Hull, of the Columbus Railway & Light Company, presented a paper on the subject of methods and means for securing new business for central stations. In opening Mr. Hull said that one of the first and most important things to be taken into consideration when the question of how best to get new business is considered, is that of complete harmony between the department having that work in charge and the other departments upon which that particular one is dependent for support.

The contracting department creates the demand, and the men engaged in this work should be thoroughly acquainted with the business, in order to meet and cope with every situation which arises. It is really the sales department, and every solicitor is a salesman, for he meets all customers on their own ground and must of necessity work under exactly the same conditions as any commercial salesman. When the salesman, however, has landed his order and sends it into the house, it is now up to them to see that the customer gets his goods according to schedule; if he does not the salesman is apt to meet with a cool reception upon his next visit. In any case too much stress cannot be put upon the importance of showing every customer, however small, every consideration possible.

In planning a campaign for new business, it would be well to divide the work as much as possible into the various classes, such as power, factory and store lighting, sign and display window, residence, etc., and, if practicable, have a man especially fitted for each class of work, which plan, if it can be carried out, will bring the best results.

The territory to be solicited should be blocked out in districts, and each district worked carefully and systematically. The only satisfactory way to do this is to make a thorough house-to-house canvass, keeping a record of the result of each interview. These records can be kept on cards and indexed so that they can easily be referred to at any time. The interviews which give promise of results and and those which are discouraging should be kept on cards of different color, so that the promising ones can be more readily followed up. The others should not be dropped, however, without receiving at least one more call, for they frequently talk very differently at the second interview. The card records admit of such a wide range in detail that one can make as many sub-divisions as wished in classifying and recording this work.

In case of new buildings it is a good policy to address a personal letter to each party taking out a permit to build, suggesting the idea of wiring and the subsequent use of current, these letters to be followed by a personal call on the owner. It is also a good plan to keep in touch as much as possible with the architects and contractors, for they can in a great many cases be of considerable assistance. It has been the experience of Mr. Hull that a very small percentage of the new houses planned make any provision in the specifications for electric lighting, and the above method has been the means of securing business from probably more than half of them, which would otherwise have been finished without wiring.

The most desirable customer is, of course, the long-hour power user, and to get him means in most cases to educate him up to it. He can be found in every city and is usually running a steam or gas engine plant with his source of power located as far from the machinery he is operating as he possibly can get it, seemingly losing sight of the fact that a great deal of power is required to turn shafting and belting. As long as his present equipment will do the work required, it is next to impossible to make any impression on him. In the course of time he is compelled to figure on more power, either because his engine is wearing out or it has grown too small for his business, and then is the time to go after him. He seldom knows what it costs him to operate, and it is the business of the central station man to show him the advantages of economy of motor-driven machinery. The man to do this must study very carefully the conditions in each particular case, and must know the amount of power required to operate the different kinds of machines. If the prospective customer is wide awake and progressive he will readily see the force of the argument when he is shown how much he can save by the intelligent grouping of such machines as are running constantly, and operating them with a small motor located in the center of the group, thereby reducing to the minimum power

lost in transmission. In the case of such machines as are used intermittently, individual motors should be installed which save expenditure of all power except when they are actually in operation. A very favorable comparison of cost can be made on a plant operating under the above conditions, and one running under the old method of driving a long main shaft from one end. These are facts with which the majority of power users are unacquainted, and when they are presented to them in an intelligent manner one can nearly always get at least a part of their business. In the case of a manufacturing plant in Columbus, which removed within the past year to a new and larger factory, the question of power was taken up with them along the lines suggested above, with the result that they gave up their intention of installing a gas engine, and equipped their new plant with individual motors, and are well satisfied that they did so. In another instance where a call was made at a factory to solicit for lighting, conversation brought out the fact that they were just about to close a contract for a 40-hp gas engine. This information, of course, started an investigation as to their requirements, with the result that they were shown that they did not need nearly so much, and a contract was made with them to install 14 hp in three motors, which will furnish them ample power for some time to come.

By making a careful study of the conditions and requirements in small shops, and even in the larger ones, one will put himself in the way of securing a part of all of their power.

Next to the power user comes the long-hour lighting customer, and sign and display window lighting is also in this class. This sort of lighting should not be taken up along the same lines that you would follow in presenting a proposition for interior lighting. It is advertising of the best kind, and as such its features should be strongly brought out. Every merchant expects to, and does, spend a certain amount of money each year for advertising purposes, and until very recently the newspapers have been reaping the harvest of the money so spent. The central station, however, has come to the front with its better facilities for presenting the merchants' goods to the public, in the way of illuminated signs which designate his location by night as well as by day, and by attractive window lighting, which displays the goods themselves to every passerby on the street, thereby reaching a large number of people who do not read the advertisements in the newspapers. The solicitor who canvasses for this sort of business must be thoroughly posted on the subject, and use his knowledge for the benefit of the customer, who will nearly always leave it to him to decide what will give the best results.

As a matter of course, they will not all make the investment required to install an electric sign, but these signs are now put up in such an attractive manner and are being so extensively used that the merchant who is progressive must of necessity consider the question. The free use of current along these lines naturally lead him to try the experiment of making his interior more attractive, which he does by burning more light, and he soon finds it a paying proposition, so that in the end he becomes a customer who uses his installation a good part of the day as well as late into the night.

Residence lighting seems to be one of the hardest kind to get, mainly from the fact that nearly all people take it for granted that the cost is prohibitive. As a matter of fact it is not, for a house can be lighted just as cheaply and much more satisfactorily by the use of electric light properly distributed as it can by any other method of illumination, and here again the solicitor must get in his good work. He nearly always has his first interview with the lady of the house, and when he has shown her that electric light is not beyond her means a few suggestions as to other uses of current, such as a small smoothing iron for her fancy work, or an electric chafing dish for little lunches—these with the knowledge that she can have a turn-down light and obviate the use of matches, will make of her an advocate, and she will use her influence to get the service into the house.

Colorado Electric Light Association.

The Colorado Electric Light, Power and Railway Association will hold its first annual meeting at Denver on October 28 and 29. This association was organized last August. Mr. George B. Tripp, of Colorado Springs, is the secretary of the association.

Recent Electrochemical Developments.

TREATMENT OF COPPER-NICKEL SULPHIDE ORES.

The treatment of the nickel-copper ores of Sudbury, Canada, is of great commercial importance and two processes there applied have achieved commercial success. The ores generally contain 1 per cent. of nickel and the same amount of copper, and also contain iron and sulphur. They are roasted and melted with an addition of limestone and coke; the resulting matte is treated in converters and then contains about 35 to 40 per cent. of copper, 35 to 40 per cent. of nickel and ½ to 1 per cent. of iron, the balance being sulphur. The problem is now to separate the nickel from the copper. Two methods have proven commercially successful for this purpose. The one is the Orford process, operated by the Orford Copper Company, and which is a purely chemical process; the other process, which is electrochemical, was devised by David H. Browne, and was in successful use for some years at the Cleveland plant of the Canadian Copper Company. The Browne process consists essentially in electrolizing first a solution of mixed nickel chloride, cuprous chloride, sodium chloride and ferrous chloride. In a bath with nickel-copper anodes and copper cathodes most of the copper is electrolytically deposited. By chemical means the rest of the copper in the solution is removed; then follows the removal of iron and of sodium chloride, so that finally the electrolyte is a solution of nickel chloride, which is electrolyzed between graphite anodes and nickel cathodes. Nickel is deposited on the cathodes and chlorine is evolved at the anodes and is then used for making new electrolyte.

In a patent recently granted to Messrs. Charles E. Baker and Arthur W. Burwell, of Cleveland, Ohio, the inventors try to solve the same problem in the following way: The ore is crushed and chlorinated. The chlorides of nickel, copper and iron are then brought into solution. "A sulphate" or sulphuric acid is added to change the chlorides into sulphates. The copper is removed by electrolysis using anodes of carbon, lead or nickel, and an e.m.f. insufficient to deposit nickel or iron. Ammonium oxalate or other salt is added to convert the nickel sulphate into such double nickel salt as may be desirable for the following electrodeposition of nickel. The latter electrolytic process is carried on with a current density insufficient to effect the deposition of iron. The iron remaining in the solution may finally be electrodeposited, briquetted and melted down.

The most obvious difference of this process from the Browne process and the older experiments of Hoepfner, is that the latter electrolyzed chloride solution, while in the new process the chloride solutions are changed into sulphates before electrolysis. Nothing is said in the specification of this patent concerning the advantages of the use of a sulphate over a chloride solution.

The chlorination stage of the process is described as follows: The ore, crushed to about 50 mesh, is placed in a revolving drum and heated by external means to about 150° C. Dry chlorine gas is introduced into the drum and combines with the sulphur to form sulphur chloride, S_2Cl_2, which volatilizes below this temperature and is, therefore, driven off to a suitable condenser and liquefied. The metals in the ore are thus changed into chlorides.

COMPOSITE METAL ROLL.

A patent, with the above title, recently granted to Mr. Charles J. Reed, of Philadelphia, does not disclose any new electrochemical principle, but is an interesting example of what can be accomplished by well-known electrochemical methods for specific purposes. The patent relates to composite metal rolls for use in the manufacture of paper and analogous operations which require rolls having hard, smooth and substantially non-corrodible surfaces. The inventor starts with a cast-iron drum with a coating of a solder which is an easily fusible alloy, and places over this coating a cover of rolled or drawn copper, nickel or brass or some other suitable alloy. A close union between this covering and the body of the roll is then effected by applying sufficient heat to weld this solder. Finally, a layer of similar or harder metal or alloy is electrolytically deposited upon the cover. In some cases it may be advantageous to deposit electrolytically an additional or third coating. For example, it is for some purposes advantageous to construct a roll of one layer of copper soldered to the cast-iron drum, electrolytically deposit a layer of tough copper upon the first copper layer, and, finally, electrolytically deposit a layer of nickel upon the second layer of copper. The advantages claimed for this roll are its ready and inexpensive

manufacture, its durability in service and its smooth, non-porous cylindrical surface.

ELECTRIC FURNACE.

A patent was granted recently to Mr. Francis E. J. Hatch, of Green Bay, Wis., for a type of resistance furnace in which the current is confined to a series of heating conductors so arranged as to produce an even distribution of heat through the charge of the furnace. As will be seen in Fig. 1, which shows a cross-section of the furnace, there is an outer cylinder of metal having an interior lining of fire brick or other suitable refractory material. A number of straight tubes of porcelain or other highly refractory material traverse the cylinder lining in close proximity to its interior surface. These tubes contain the heating conductors, consisting of a series of small cylindrical carbon or graphite blocks of such a diameter as to snugly fit within the bore of the tube. At both ends of each tube springs are provided which press the graphite blocks in each tube together.

The advantages claimed for this construction are that the graphite or carbon conductors are efficiently protected from being wholly or partially destroyed by abrasive contact with the charge, and at the same time they are arranged to disseminate their heat at practically the interior surface of the lining of the furnace. The construction of each heating conductor in the form of a series of graphite blocks has the advantage that, although continually held in contact with each other by the action of the pressure devices at the opposite ends, the short sections of the carbon conductor never form a completely closed circuit throughout the entire sectional area of a block, and constantly incipient electric arcs are formed between adjoining blocks. The heating effect of such arcs is rapidly manifested, and by properly proportioning the blocks they may be brought to intense incandescence from end to end, so that practically the entire conductor is brought to an intense heat. The pressure of the springs upon the ends constantly tends to take up the wear due to the formation of the arcs and to maintain the blocks in proper contact.

PRODUCTION OF NITROGEN COMPOUNDS.

A patent, recently granted to Mr. Guillaume de Chalmot, of Leaksville, N. C., relates to the production of nitrides of metals or metalloids in the electric furnace and the production of ammonia from such nitrides. If oxides or salts are mixed with carbonaceous matter and heated in the electric furnace while a current of nitrogen is passed through the material, the formation of nitrides results with

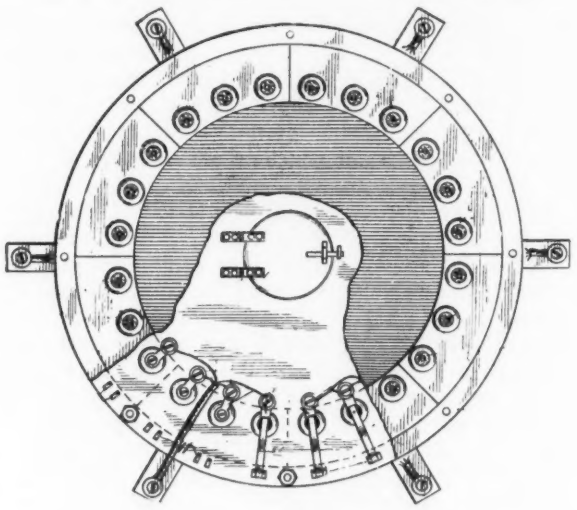


FIG. 1.—HATCH ELECTRIC FURNACE.

occasional traces of cyanides. Nitrides of calcium, barium, aluminum and titanium can thus be obtained. It is not sufficient to pass the nitrogen over the heated mass in the furnace, but it must be forced through the charge. To this end the inventor conducts the reaction with an excess of carbon whereby the material is rendered very porous, whereby the nitrogen can be forced through the entire porous mass and brought into intimate contact with all the reduced metal. In order to obtain ammonia from these nitrogen compounds, they are treated with steam at red heat. The steam should first be superheated, but if not it will become so on the contact with the hot compound. In the case of barium, calcium and other basic elements, the ammonia is easily obtained in this manner from their nitrides or cyanides. In the case of titanium it is preferable to mix its nitride with a basic oxide and then subject the mixture to superheated steam.

The inventor prefers to produce both the formation of the nitride and the production of ammonia in the electric furnace, by simultaneously forcing nitrogen and superheated steam through the charge. In order to make the operation continuous he feeds continually fresh material from above into the furnace and causes the charge to slowly descend at a rate to insure that the greater part of the material shall be acted upon and reduced by the electrically-generated heat in the furnace, the nitrogen being introduced at the top of the furnace and circulated downwards past the electrodes, and the superheated steam being introduced preferably beneath the electrodes. The entire mass gradually descends and is finally removed at the bottom of the furnace. As titanium takes up nitrogen more

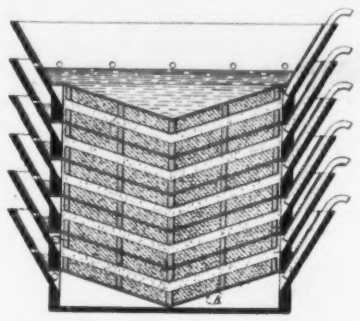


FIG. 2.—KENNEDY STORAGE BATTERY.

readily than any other element the inventor prefers to employ titanium oxide (rutile, brookite or anastase) or high-grade titaniferous ore.

STORAGE BATTERY INVENTION.

A patent granted to Mr. Charles W. Kennedy, of Rutledge, Pa., for improvements in the field of storage batteries, relates to a series of cells, trays or cups nested to form a battery of required size. The general appearance of the battery, shown in Fig. 2, is quite similar to the former apparatus used in the Salom lead reduction process. There is provided a bottomless separator tray having flaring sides and an inner offset supporting portion. A metallic dish is supported by this offset portion and the positive and negative electrodes are supported by this dish.

A patent recently granted by Mr. I. L. Roberts, of New York City, describes a diaphragm for use in double fluid batteries. The diaphragm is made of glass cloth having its interstices filled with gelatinous material. Such diaphragms are said to resist the action of the strongest acids and, on account of their flexibility, they are easily secured in place in a battery, and will stand severe jolting without injury. The glass cloth which he has found best suited for the purpose is tightly woven of very finely spun filaments of glass, a large number of such filaments composing each thread of the warp and woof. This makes a fabric of close texture containing innumerable spaces or pores which are filled with a gelatinous electrolyte.

MISCELLANEOUS.

A patent recently granted to Mr. William H. Davis, of Boulder, Colo., refers to a process of treating cyanide solutions during or subsequent to their contact with the ore, whereby the double salts in the solution are dissociated and the regeneration of the cyanide in the solution is simultaneously accomplished with the purification of the solution. The process consists essentially in adding an alkaline hydrate to the contents of the storage or leaching tanks, and then subjecting the mixture to the action of an alternating electric current to break up the double salts and precipitate the base metals and combine the cyanogen radicle with the alkaline hydrates to regenerate the alkaline cyanide. Mr. George W. Frazier, of Allegheny, Pa., is the patentee of an apparatus for the electrolytic purification of water, the invention claimed referring to details of mechanical construction. A patent granted to Mr. Albert R. Pritchard, of Rochester, N. Y., relates to details of mechanical construction of an apparatus for plating sheets of metal on one side only; for instance, for coating parts of sheet metal ware vessels on one side with zinc.

Meeting of the Ohio Electric Light Association.

The ninth annual meeting of the Ohio Electric Light Association was held at Hotel Chittenden, Columbus, Ohio, on October 13-15, 1903. This Association comprising, as it does in its membership, all of the principal central stations of Ohio, always holds interesting meetings, and this was no exception. The programme of this year was a departure from the ordinary in that it gave considerable attention to boiler and engine room economy and equipment. The attendance of members, however, was somewhat below the average, and it is thought by some members that the dates are set too late in the fall, when the busy season keeps many from attending. On the other hand, representatives of electrical manufacturers and supply dealers were present in full force. President W. O. Thompson and the faculty of the Ohio State University, gave a reception to the members of the Association on Wednesday evening. Here the party was received by Profs. W. O. Thompson, Edward Orton, Jr., F. C. Caldwell, E. E. Hitchcock and W. T. Magruder.

Officers elected during the session for the ensuing year are as follows: President, S. M. Rust, Piqua; vice-president, J. H. Perkins, Youngstown; secretary-treasurer, D. L. Gaskill, Greenville. Advisory Committee—D. L. Gaskill, Greenville; Samuel Scovil, Cleveland; L. G. White, Columbus. Executive Committee—A. W. Field, Columbus, Ohio; W. F. Hubbell, Wauseon; A. C. Blinn, Sandusky; J. F. Bendure, Lima; C. Johnson, Akron. Finance Committee—E. H. McKnight, Middletown; Edward Plaisted, Kenton; E. F. Gwynn, Delaware. President Rust is familiar with conditions in the State, having been connected with the management of his home company for the past ten years, and will make a popular official. Mr. J. H. Perkins, of Youngstown, has for the past two years made a most painstaking and efficient secretary, and his advancement to the vice-presidency is a deserved recognition. The incoming secretary-treasurer, Hon. D. L. Gaskill, in addition to being a past-president, is a forceful man who doubtless will make many accessions to the membership during the coming year.

President A. W. Field, of Columbus, in his annual address, briefly reviewed the objects of the Association, viz., the fostering of the common interests of its members, the advancement of scientific and practical knowledge in matters relating to electric light and power companies, and the establishment of cordial and beneficial relations with kindred associations; and both in his address and at other times referred to the mutual interests of the members of the Association and representatives of electrical machinery and appliances. He referred to the benefits conferred upon the smaller plants, especially, and after thanking the Association for honors conferred upon himself, predicted that the Association would continue as in the past to maintain a high position of usefulness in its chosen field. Following are abstracts of the papers read and of their discussion:

Mr. W. D. Chester, in a paper entitled "Steam Boilers for Power Plants," after treating the principles of combustion, evaporation and fuels, described in general terms the various types of boilers now in use, and pointed out the advantages of the water tube boiler, dwelling upon its adaptability for high pressure and the quickness in which steam may be raised in it. As an illustration of this latter point he referred to a large power plant in Washington equipped with marine boilers in which it is necessary to begin to get up steam five to six hours before the peak load comes, or rather is due. As a contrast to this, and as showing the possibilities of the sectional water tube boiler a case was mentioned where a 265-hp water tube boiler was blowing off steam at 215 pounds' pressure in less than fifteen minutes after fire was lighted in a cold furnace with the water in the boiler at 72° F. An emergency capacity test of this same boiler of three and one-half hours' duration showed an average of 13½ pounds of water per hour, per square foot of heating surface, or four and one-half times its nominal rating, and that without the slightest sign of straining or overheating in any respect. The average rate of combustion on this test was 59½ pounds of Pocahontas coal per hour, per square foot of grate surface; and the water evaporation was 10.15 pounds of feed water from and at 212° F. per pound of combustible. This was a standard size and type of boiler which has repeatedly shown its ability to successfully, and without sign of distress, duplicate this performance.

Mr. D. S. Kohler, of the Columbus Railways & Light Company, opened the discussion on Mr. Chester's paper, and asked if the author had any data as to amount of saving from use of superheaters, and as to how the superheaters made by his company compared with those known as independent superheaters. Mr. Chester stated that his company made both kinds, but the separately-fired had not met with much success. A test of a McIntire compound steam engine in Columbus, Ohio, after running the same battery two days not superheated, and then two days superheated, showed a saving of ten or eleven per cent. in pounds water evaporated per kilowatt generated. Prof. Hitchcock, of the Ohio State University, asked in the case of a boiler being run at 50 per cent. overload, what will be its life of it comparatively speaking, with good water supplied and boiler cleaned properly? Mr. Chester said he could not answer definitely, generally speaking; the particular case cited by him in the paper was with forced draught, with boiler room enclosed. Mr. Goldsmith cited a test made by the Southwark Foundry & Machine Company, Chicago, at the Commonwealth Electric Light Station, where a 1,250-hp engine using 100° superheat, under 150 pounds pressure, showed a consumption of 10.7 pounds per indicated hp-hour. The engine was a Porter cross-compound, vertical, four valves for each cylinder. The test was for 6 hours on a water rheostat load. Inquiry made as to the advantage of enclosing the boiler room, as compared with enclosing separate ash pits, elicited the statement by Mr. Kohler that the former practice was a simpler arrangement, and on that account adopted.

The president suggested discussing in this connection methods of cleaning boilers, and asked for an expression from Mr. Perkins, of Youngstown. Mr. Perkins stated that the water there was as bad as Pittsburg water and developed a great deal of scale; he thought this difficulty had been much aggravated since they had used water tube boilers, and they had been compelled to find an efficient method to remedy the conditions.

He deprecated the use of a hammer on the tubes, and is using a Weinland tube cleaner. He had tried four different boiler compounds, with fair success, and had finally adopted a combined process of boiler compounds and mechanical cleaner, the latter operated by a motor running along in front of boiler. Mr. Kohler thought there was less scale with water tube boilers. Mr. Perkins said the trouble was not more scale, but one could not get at it so well to clean it out. Mr. Kohler referred to the advantage of standing outside and working a machine on a water tube rather than going inside and using a hammer. Mr. Kohler said he had found no trouble after cleaning the same tubes five years at least three times annually. The cleaner rather tended to put a polish on the tubes which protected them somewhat. Mr. Perkins coincided, and had also found no ill effects from boiler compounds as to pitting, although this might be possible with some compounds if used in sufficient quantity. Mr. McKnight in reply to inquiry stated that he used crude oil and found it to give good satisfaction, although their water was very bad. Referring to bagging, it was stated by Mr. Kohler that he never found a tube bagged above the first row. He had never heard a satisfactory explanation of this. Prof. Hitchcock declared in favor of a fire-brick arch or Dutch oven Turner furnace, especially with use of bituminous coals, as a means of protecting the heating surface, and tending to distribute the heat better. Mr. Kohler asked if any one had used the Shelby seamless drawn tubes, and with what results? Mr. Perkins stated that after careful investigation and keeping track of every tube by number, they had settled down to the Tyler charcoal iron tubes, which could be bought at three-fifths the cost of the Shelby. Mr. Kohler had not obtained any better results with the seamless than some others on the first row of tubes.

In a paper entitled "Engine Economy and Equipment," Mr. E. J. Bechtel, of Toledo, Ohio, referred in general terms to the several types of prime-movers, and pointed out that in designing the engine equipment for a central station it is neither the engine having the best steam economy on the one extreme nor the engine having the least first cost on the other extreme, which is to be considered the most efficient; but it is the engine which is best adapted to operate under local conditions as they exist, or under conditions which can be brought about. In other words, all conditions including interest on investment, etc., should be carefully studied, before deciding upon the proper equipment. Upon the combination of all conditions depends the advisability of using high-pressure steam, superheated steam, vertical or horizontal, simple or compound, condensing or non-condensing, high or low-speed engines, size of units, with or without steam jackets, reheating coils, superheaters and various other appliances, which tend to change the conditions of economy. The economy of the central station, moreover, does not depend entirely upon the design of the equipment, but also upon the operating force, which can in a great many cases lessen the

efficiency of a well-designed station or increase the efficiency of a poorly-designed one by their method of operation. Thus, the importance of carefully selecting an operating force which will give maximum results with the least cost, is apparent. The force should be carefully made up of men capable of promotion with the knowledge that a defined line of promotion is before them, depending upon their ability and time of service, without any show of favoritism. In this way only will we be able to get the proper grade of help to begin at the bottom and at a salary in proportion to the position.

Mr. Bechtel regarded with some favor the possibilities of the steam turbine for central station requirements, their capacity at present, he stated, being limited to 500 kw per unit for direct-current work; gas engines he considered a doubtful factor.

In the discussion Mr. Gaskill asked as to the relative cost of the turbine as compared to the Corliss type of engine. This, Mr. Bechtel stated, depended upon the size of the unit; he had in mind a 2,000-kw unit, and the cost of that with an engine and generator as compared with a turbine and generator, is in about the proportion of 7 to 10, in favor of the turbine; that is, not including the condenser or air pump. He did not know the exact cost of the engine alone as compared with the turbine alone. As to the limit of 500 kw for direct-current when there is no such limit for alternating current, he said this is due to the commutator; the turbine necessarily having a high speed of 1,500 to 3,000 r.p.m., allows of only a small armature, and on 500 kw at 500 volts the ampere capacity would be about 1,000 amp. He had seen in operation a 500-kw, 500-volt, direct-current turbine, which had two commutators of about 15 in. diameter, and perhaps 15 in. to 20 in. face each, which was entirely out of proportion to the diameter. In reply to a question as to the advantage gained by using direct-connected instead of belted units, Mr. Bechtel said there was a little better efficiency in favor of the direct-driven. In reply to a question, he said that a 100-hp turbine operating condensing would require with 28-in. vacuum about 20.5 pounds of water per kw-hour. The main efficiency of the turbine is in the condensing apparatus. It is very essential to have a high vacuum, and also superheated steam if possible. The main economy is in these two points.

In the discussion following several members gave opinions unfavorable to the gas engine because of its unreliability, and disposition to go on "strike" just when its services were most desired. It was subject also to fluctuations which in an individual plant might be overlooked, but not in the case of a public lighting plant where the service is constantly open to criticism. Gas engines, Mr. Gaskill thought, were faulty in the two principal respects of unreliability and fluctuation. Mr. Field thought they could be used in railway work up to certain sizes, but concurred with other speakers as to unreliability for electric light work. Mr. McKnight had had a like experience. Perhaps the difficulty was mainly in getting a properly equipped engineer to look after the gas engine at the price most people could afford to pay them for units of smaller sizes.

Prof. Magruder said he thought the unfavorable opinions with respect to the gas engine had come from gentlemen who were unfamiliar with the gas engine's capabilities. He instanced a plant in Lancaster, Ohio, which had been using gas engines for five years for electric lighting work satisfactorily. Gas engines of 150 hp had generated on about 10 cu. ft. of gas per brake hp-hour, which he considered was equivalent to something under 12 pounds of steam per brake hp-hour; so that when it came to the question of heat units, the gas engine can deliver the goods. One of his German friends had written that he had designed a 5,000-hp unit, and one of his own students had designed a 45 x 54 crank-pin 20-in. diameter engine which is being built by the Allis-Chalmers Company. The foreign makers were guaranteeing regulation of their gas engines, and in America there is a great future for the gas engine.

Mr. J. H. Perkins presented a paper entitled "Development in the Engine Room," in which he dealt with improvements made in the plant of the Youngstown (Ohio) Consolidated Gas & Electric Company since 1900, in which year Mr. Perkins described the plant before the association in a paper entitled "Operation of a Combined Lighting and Power Plant." In this period the former belted machines have been replaced by direct-connected, two-phase generators. The former arc light circuits are supplied from constant-current transformers, and the 500-volt direct-current power service from rotary converters, where single-phase and two-phase motors have not been substituted.

One of the first difficulties when the change was made was in the parallel operation of the direct-connected units. There had been no trouble with belted machines, but considerable trouble with the first direct-connected machine, not when operating with the belted units, but in operating rotary converters and operating in parallel with the direct-connected machines. It was found that the trouble did not lie in the fly-wheel nor in the variation of the engine speed in each revolution. A good share of the trouble was found in the rotary converters, and a dash-pot on the governor of the engine was found to be a cure for almost any trouble in parallel operation. The troubles in the rotaries were easily remedied. Any engine in the plant will pump and cause all kinds of disturbance if the dash-pots are out of order, and some of them would not work an instant in parallel without a dash-pot. Mr. Perkins considers that it would be very much more difficult to get the same results by the use of heavier fly-wheels.

In the matter of engine regulation 3 per cent. was decided on as about the best that can be expected with good, reliable, parallel operation. Some of the manufacturers say that this should be fully 4 per cent., but it can be made as small as one pleases by taking all the kinks out of the governor by dash-pots or otherwise, thereby causing smooth rotation or regular angular velocity.

In the changes a backward step was taken in only one feature, namely, voltage regulation, and this seemed unavoidable. The main cause has been the greater increase of railway load as compared with lighting. With 50 per cent. lighting and 50 per cent. railway load, the service would be entirely satisfactory when operated from the same machines; but if railway load is added in greater proportions the disturbing effect will become noticeable, especially if the machines are overloaded. To overcome this at times when it seems desirable to operate both light and power together, a voltage regulator of the latest type is being installed. It is safe to say, however, that at all times a regulation is obtained that would be impossible under the same conditions of load and manner of running on any other systems, except by the use of a storage battery of ample size.

In the period from 1900 to date the lighting output has increased 142 per cent., the railway output about 800 per cent., and the power motor output about 200 per cent.; the increase in total output being about 440 per cent. The load factor has increased from about 25 per cent. to 50 per cent., and there has not been a single shut-down due to the engine room. The economy in the engine room has increased to a wonderful degree, not only in improving the load curve and by reason of the large output, but by reason of the change in the type of apparatus. The greater part of the saving has been made in labor and maintenance charges. For an increase of 225 per cent. in capacity the engine room labor has only increased 57 per cent. There has been a decided saving in maintenance of electrical apparatus, this account having dropped to almost nothing.

Questions were asked by Messrs. Bechtel, Hayler, Bailey, Prof. Caldwell, Mr. McKnight. Mr. Perkins said that they had to-day practically no trouble with their rotaries, although they had at first experienced some by reason of their not operating properly from the vertical engine. Some of his sub-stations are not inspected once in three months because not found necessary. They were understood to be the pioneers in the operations of 60-cycle rotaries, and had now found how to operate them without any trouble, the commutator being the principal thing that requires watching.

Mr. George Hayler, Jr., of Van Wert, Ohio, in a paper entitled "Steam Records," advocated the keeping of a steam logbook, in which the following entries should be made: The names of engineers and firemen on duty and the hours each works; the number of engines and boilers in service and the hours run by each; the amount of coal burned by each fireman or group of firemen, and the total coal burned in 24 hours; the amount of water pumped into the boilers during the same time and the approximate evaporation figured from these data; the steam pressure, temperature of feed water, atmospheric temperature and water, and the amount of cylinder and other oil used by each engineer and the amount used of waste and packing. Indicator cards should also be taken from time to time and a record made of the time of stopping and starting each engine. From the data of the record load curves should be constructed daily. The paper also dealt with the economics of the boiler room.

In the discussion of Mr. Hayler's paper Mr. Perkins told of some important and valuable results that had been reached through tabulation and study of records in saving in coal consumption, and illustrated his statements by plotting curves on the blackboard.

Burning about 90 tons of coal per day, they had in one instance saved through information thus derived some $40 per day in coal consumption. In answer to a query from Mr. Gaskill as to where the leak had been, he stated that it was because of operating the furnaces and boilers at under capacity—too much boiler capacity for the load. To get best results they had to operate at 25 to 30 per cent. over the rating of the boilers. He used 400 hp of Roney stokers.

Mr. A. C. Blinn, of Sandusky, Ohio, in a paper entitled "The Value of Station Records," argued strongly in favor of small central stations keeping complete records of plant performance. Aside of the value of such records in revealing where economies may be practised, is their advantage in case a plant is to be sold, through preventing underestimation by the prospective buyer.

In the discussion Mr. Bailey emphasized the value of records outside of as well as within the station proper, in which Mr. Blinn heartily concurred.

Mr. D. L. Gaskell, of Greenfield, Ohio, delivered an address upon the new Ohio municipal code as affecting Ohio electric light companies. He pointed out the steps that will have to be taken under the new code to contract with a municipality, and explained wherein they are different from the several requirements under the old rules. Mr. Gaskell, in conclusion, said that taken as a whole the new code will not make any material changes as affecting electric light companies, and that while it has cleared up a few ambiguities it has introduced others. He considers what is needed is a clear and comprehensive chapter of sections limiting the power of municipalities to engage in municipal ownership and giving the right to contract for a long term without restrictions as to vote and consents of any except the boards in charge of making city contracts.

Mr. Charles T. Mossman read a paper entitled "Notes on Certain Three-Wire Systems," which will be reprinted in full in the following issue.

The first paper of the session of Wednesday afternoon was read by Mr. K. C. Randall, of Pittsburg, on "Some Practical Considerations and Applications of Transformers." The writer took up four points as of especial interest to the station operator, viz.: (1) The first cost; (2) amount of power consumed in losses; (3) the continuous and overload capacity; (4) the life of the transformer. These were considered with reference to different classes of service, attention being paid to the time of heavy load and light load; also to the requirements where overload might exist. By means of definite examples the relative value of two transformers was illustrated; also the great superiority of a transformer, which normally operates at a low temperature rise, and, therefore, having large overload capacity, over one with a high temperature rise, and, therefore, little or no overload capacity. As a summary, durability, life and low temperature were shown to be practically synonymous, and the result of low losses in a good design. The features of the so-called double-ratio transformers were also illustrated by means of ratio curves, and several examples cited to illustrate their application.

During the discussion it was asked if the iron loss with such transformers when operated at a 9 to 1 ratio would not have an excessively high value. To this was replied that the purpose of the double-ratio transformer was to obtain a constant secondary voltage in spite of a variation of 5 to 10 per cent. in the primary voltage, so that when a constant secondary voltage was delivered, meaning no change in the induction density throughout the core of the transformer, no increase in the iron loss would result. Mr. Randall said that other features of the double-ratio transformers are that where an increased secondary voltage is desired for operating, say, induction motors on an all-day service, the slight increase of iron loss due to increase in the secondary voltage would be practically negligible, and still permit the operating of the motor at a higher voltage, and, therefore, reduce the copper loss. The importance of replacing many small transformers by a single larger one was dwelt on and illustrated by a definite example showing the actual monetary gain by such a change, as well as the gain due to putting several transformers in reserve which were replaced by the single larger transformer. To produce good transformer iron minute attention must be given to the iron in all its steps of treatment to prevent aging. Importance of accessibility, convenience of handling, for all transformers, and particularly the larger sizes, was referred to. A short reference was made to the use of balancing coils for operating three-wire systems, or obtaining a double voltage or heavy voltage, as might be desired. Transformers should be properly arranged for three-wire operation; this was illustrated by an example showing the trouble arising from an improper design. A number of examples with time and temperature and time load curves were given, showing how a transformer of small normal capacity but of large overload capacity should be used where a much larger transformer capacity would be required for short periods.

In the discussion Mr. Troy, of Schenectady, asked if the other qualities of a transformer, such as regulation, C^2R loss, etc., might not be limiting features just as much as heating? Most central station men are equally concerned with the matter of regulation and copper loss. The overload capacity of a transformer is just as much a function of the regulation and C^2R loss as it is of the heating. Mr. Troy urged the necessity and desirability of a fixed standard of temperature on which to base regulation and efficiency of transformers under discussion. If such a universal standard was accepted he thought the standard set by the American Institute of Electrical Engineers, namely, 50° C. maximum rise, is the logical one to accept. Mr. Troy asked the writer of the paper to state what is the regulation, C^2R loss and heating of a 5-kw transformer on the basis of a 5-kw and a 6-kw load?

To this Mr. Randall replied that in such case one would practically get the benefit of the low iron loss for the nominal load for 5 kw, and there would be a pronounced gain that way; the copper loss would be larger, but just how much he could not state.

Mr. Troy thought that in operating a line containing transformers of various ratios, the lamps on the line would be subjected to dangerous voltages under light load conditions, and it might well be asked how much would this voltage vary during different parts of the day in the example cited by Mr. Randall, where transformers of three different ratios, 9, 9½ and 10 to 1 were used on the same line? Would not the saving in line construction be more than offset by the poor all-day efficiency of the transformer, etc.?

Mr. Randall replied that if a 9-to-1 ratio is used all over, the iron losses, which are pointed out as being very prominent, would be increased, but would even then be quite low, while the gain in regulation and gain in reduced copper loss would perceptibly offset the iron loss, and there would be increased regulation, which would be a substantial gain. In reply to a question by Mr. Holt, regarding the relative efficiency of a 50-per-cent. and a 150-per-cent. load, Mr. Randall said this would depend upon the proportions of iron and copper loss. Assuming a transformer with an iron loss of say 1½ and a copper loss of say 2 per cent., at one-half load, the iron loss would come down about 66 per cent., or just about to 1 per cent., and the copper loss would go up to about 4½.

Mr. Turner thought that regulation is one of the most vital points in the distributing system; if one cannot maintain a uniform voltage on a distributing system, he loses one of the great advantages that electric light has in competition with other illuminants. If at light load the lamps will receive a very high voltage and are burning at standard voltage only at the time of maximum load, it not only means that the lamps' life is shortened, but that those customers who have their maximum current at an earlier period than others will notice the difference between the candle-power of their lamps at one time of the day and what it is at another time. The question of candle-power is mostly one of comparison. The best way to maintain a distributing system is by the use of feeders and sub-feeders; otherwise uniform voltage cannot be maintained. Mr. Turner feared that some of the advice given was wrong in that it did not develop the distributing system along lines that are being to-day recognized by the larger stations as the proper lines for development.

Mr. Bechtel desired to emphasize the remarks of Mr. Turner; the use of the double-ratio transformers is equivalent to using, say, 110 volts at one station and 100 volts at the end of the line, with poor regulation; the tendency would be increased cost of current to the customer, just what to avoid. Mr. Bechtel thought the position taken by Mr. Randall of substituting one large transformer for a number of smaller ones was very good, although in many cases the point is overlooked.

Prof. F. C. Caldwell, of Columbus, Ohio, read a paper on the "Combined Use of Alternating and Direct Current for Central Station Work," in which he considered the question, "In what proportion should the alternating and direct current be used in any particular plant?" His conclusions are that in the case of newly-established plants of the present day the evidence seems to favor, for the smallest plants having no large concentrated load and little or no elevator work, a distribution entirely by alternating currents. For larger stations located near their load centers, there seems to be no doubt

about the use of direct current supplemented by the storage battery for the district surrounding the station and including the concentrated load, and the generation of alternating current for transmission to and distribution in the regions more distant from the station. For the generation of power in this case, several different arrangements are possible; one of them is the use of double-current generators, but a difficulty presents itself here in that these are usually made for a frequency which is too low for satisfactory lighting. Another plan is the use of the direct-current generator and steam turbine alternator with a rotary converter to connect these, and make it possible to carry the whole load, when light, on either of the two machines alone. In some cases it may be possible to omit one or the other of the generators, at least temporarily, producing all the power as direct current and converting for the alternating-current distribution, or vice versa, according as the demand for one or the other form of current is the greatest. Lastly comes the case of larger towns where it is desirable to generate the power at a greater or less distance. Here the almost universal practice is to have rotary converter sub-stations at the center of the concentrated loads, where the alternating current generated at the main power station or stations is converted to direct current; this is then distributed as such with the aid of the battery located in the sub-station, while the more distant and less concentrated districts are supplied with the alternating current. Here the question of frequency comes in again as a complicating factor. Rotary converters operate more satisfactorily on low frequency, but this is not suitable for lighting purposes; the question, therefore, must be decided as to whether to sacrifice the best interests of the converter stations and use a frequency of 60, or to use 25 periods for the transmission to the sub-stations and to raise the frequency to 60 for use in the suburban districts. Of course, the relative importance of the two kinds of service would have considerable influence in deciding this question.

Next Prof. Caldwell considered the problem of the adaptation of plants already installed so as to fit them for modern conditions. Such plants, if located near the center of distribution, will generally be direct-current plants, and direct current will be retained for the service in the vicinity of the power house, alternating generators being added for the more distant districts. If the establishment of a distant generating station is warranted, the old power house will usually become a sub-station with rotary converters for supplying the old direct-current districts, alternating-current districts being supplied directly from the new generating station. The old machinery may be dispensed with entirely or maintained simply for emergency work, as for the peak load of nights during the Christmas holidays; if, however, the direct-current equipment is modern, it may be kept in constant commission to take care of the daily peak, the load during other hours being taken care of entirely from the main generating stations.

Assuming that the plant is to comprise both alternating and direct-current distribution, the question arises as to what part the direct and alternating currents should take, respectively, in the distribution. Three different arrangements are possible; the districts covered by the direct and alternating currents may be entirely separate, or the alternating and direct currents may both be available to the consumer throughout a considerable part of the system; or the alternating and direct-current districts, while in general separate, may overlap on their borders. The first of these conditions, if practicable financially, would be the most satisfactory to the consumer, making it possible for him to have either form of current as best suited to his particular needs. It is doubtful, however, whether conditions would often permit of such a double distribution unless it were in a case where polyphase alternating currents were used for the general distribution of light and power supplemented by a 500-volt direct-current circuit, used only for such motors as required this current for their satisfactory operation. Otherwise it would seem that the entire separation of the districts covered by the two forms of current would be the only arrangement that could be worked without danger of a considerable amount of friction with customers desiring a different form of current from that most available in their district.

At the conclusion of Prof. Caldwell's paper President Field said that he felt confident the Association highly appreciated the value of such a contribution to its proceedings. Mr. Bechtel said he had no criticism of the paper, which he thought had fully covered the ground; but it had suggested the thought to him of the great importance of stations designing their systems or modifications thereof with regard for the future. Designs that were not antiquated intrinsically often became useless because of their small size and inadequacy to meet the conditions of growth and extension. He called attention to the new lamp, the magnetite, recently designed by the General Electric Company, in which there is no depreciation of the copper electrode; a stick of magnetite 5/8 in. in diameter and 8 in. long burns about 150 hours without an inner globe, being really an open-arc lamp. It is not adapted to inside work on account of the smoky deposit, but is very good for street lighting. If adopted it will bring direct current into favor again and possibly revive the old Brush machines, unless a suitable converter can be found to transform alternating into direct current. The Westinghouse Company also has a luminous arc lamp called the Bremer. Both these lamps are very economical, the magnetite being an especially long-burning lamp. They consume about 300 watts and either of them will compare favorably with the present open arc at 450 watts. The rapid increase of interurban roads must also be considered by many stations and new installations, so that stations can be added to as may be necessary. In a new station the generating apparatus should be entirely alternating current; 25 cycles would be the best frequency. This would necessitate frequency-changing sets of 60 cycles for alternating-current lighting. From the 25-cycle generator could be operated all of the system by means of rotary converters. The mercury vapor or Cooper Hewitt lamp is a very efficient one, but Mr. Bechtel thought it would not come into commercial use soon. The alternating-current railway motor is liable to come into general use; both the General Electric and Westinghouse Companies are working on single-phase railway motors. In a trip taken on a car at Schenectady, while the car did not accelerate probably as fast as with a direct-current motor, it obtained good speed and picked up fast by sacrificing power factor at the start.

Mr. Turner stated that while he had not heard any figures given at this meeting, the general impression seemed to be that the area of direct current was very limited; he believed that it was generally conceded that direct current can be distributed over a radius of close to a mile at a greater advantage than alternating current, and that by the use of sub-stations and rotary converters that area can be very largely extended. Direct current has always the advantage that is at least up to date and of greater reliability of service than the alternating-current system. With a direct-current, low-tension system a network of mains and feeders and a storage battery, a city is practically sure of a 24-hour service with no interruption from one year's end to the other; and there are very few alternating stations that can point to a record of continuous operation for one year. Dr. Bedell, of Cornell, has worked a great deal on distributing both alternating and direct current over the same feeders and mains at both high and low tension.

In closing the discussion of his paper, Prof. Caldwell said that he had hoped that his paper would elicit some opinions as to the importance of the storage battery in the modern central station; whether it is so essential as to make it worth while to give up the advantages to be gotten from alternating-current distribution is a very live question at the present time. Along the line of Mr. Bechtel's comments, as to the Cooper Hewitt mercury vapor lamp, it might be added that when this lamp was first presented last July at the American Institute of Electrical Engineers' convention, they had a little musicale with refreshments on the lawn served by negro waiters; the negro waiters came out a beautiful pea green!

Mr. M. C. Hull, of Columbus, read an excellent paper entitled, "Methods and Means of Extending New Central Station Business, which is reprinted elsewhere in full. In the discussion of this paper, Prof. Caldwell said that the great convenience from the use of electric current was a point that could never be overdrawn when approaching a customer, especially in a natural gas territory where there was so much to contend with; the ease of turning on an electric light in a cellar or any remote part of the house without striking a light was a great inducement as a matter of convenience.

Mr. Bechtel spoke at some length on the contract department of the central station, and the advisability of keeping such a record of individual cases that even if the solicitor left the service, the new man would be at once prepared to take up his work where it was left off. With natural gas at 30 cents in a city Welsbachs were cheaper, but could be offset by other advantages offered by electric light; tact and looking after the interests of the customer were also powerful factors in soliciting and in making the public your friend.

Mr. Hayler urged that pains be taken to cultivate the architects and see to it that when the wiring is done it be put in as conveniently for the occupant as possible, and thus the customer would become the staunch adherent of the electric light. Mr. Perkins stated that Youngstown had no regular contracting department, but wherever they learned of new buildings it was arranged, if possible, so that nothing but electric light would be used. Keeping in touch with the architect is a very good thing. The architects come to the electric light company to get the form of their specifications, and naturally they are accommodated. Mr. McKnight had found his customers often his best friends; he instanced a case where a lady used electric light, although her husband was the manager of the gas company, because she found that the handsome decorations of her house had been nearly ruined by the gas fumes. Mr. Blinn reported that they suffered a great deal in his city (Sandusky) from bad wiring, and they had accordingly established a rule that connections would not be made for electric light unless the company had first inspected and favorably passed upon the wiring of the house; the rule had worked very satisfactorily.

Mr. W. F. Raber, of Mansfield, Ohio, in a paper entitled "Electrical Distribution in the Engine Room," described the equipment of the Mansfield Electric Light & Power Company, which, however, he did not hold up as an ideal one from the economic standpoint. It is the intention of this company to install three-phase generators direct-belted to each of the Corliss engines now installed, and to take from these power for all classes of lighting and for small motors and install rotary converters for direct-current power customers and for railway service. A storage battery will also be installed to float on the railway and power circuits, thus enabling the engines to do their work at the economical point, the battery to be depended upon also to take care of the peak loads. It is also proposed to install a steam turbine, the turbine to be run regularly and the other engines held in reserve or used when necessary to carry the heavy winter peaks on the lighting circuits.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY ON THE PACIFIC.—A special dispatch from Port Townsend, Wash., of October 17, says: "The plant of the Pacific Wireless Telegraph Company was thrown open to the public here to-day. The apparatus worked satisfactorily on the initial message, which advised President Roosevelt of the completion of connections at Fort Casey on Whidby Island with the land lines of the big telegraph companies. Following this a large number of congratulatory messages passed between Fort Casey and this city."

THE SNOWS OF YESTERYEAR.—A cable dispatch from Paris of October 17 has this melancholy item of news: "The last vestiges of the Exposition of 1900 are rapidly disappearing. The great statue and its supports on the Palace of Electricity were demolished this week. The gigantic female statue of the Genius of Electricity, weighing 30,000 kgm. and standing at a height of 80 m., was overthrown, causing a deafening noise and clouds of dust. Nothing remains of the beautiful palace but heaps of bent iron and shattered glass. The detonation caused a great disturbance among the cavalry horses now quartered in the machinery hall, but there were no accidents."

A LARGE FLUME.—The steel flume to be used by the Ontario Power Company at its plant at Niagara Falls, Ont., will have a diameter of 18 ft. and will be 5,880 ft. long, the plates being ½ in. thick. On account of the difficulties attending the transportation of so large a pipe, a temporary plant will be erected on the Canadian side for the purpose of constructing the flume. Its construction will require from 10 to 16 months. The flume will extend from the forebay of the Ontario Power Company along the base of the bluff, at the rear of Queen Victoria Park, to a point just below Table Rock, and there its waters will be diverted through penstocks to turbines to be installed in a power house at the water's edge.

NEW YORK ELECTRICAL SOCIETY.—The Society held its first meeting of the season on October 19 at the American Institute, when Prof. W. E. Ayrton, F.R.S., member of the Mosely Educational Commission, delivered an informal address on some electrical measuring instruments as developed in laboratory work upon a study of the resistance in the electric arc. To an audience of about 300 the speaker made his subject full of interest and instruction throughout the evening, the exposition being accompanied by references also to books, diagrams and lantern slides. Some of the data and results brought forward had not been previously made public, and will form the basis of subsequent papers. President J. J. Carty was in the chair, and among the speakers were Dr. Pupin and Messrs. L. B. Marks, Wilson S. Howell and T. C. Martin. The secretary, Mr. Guy, has prepared an admirable programme for the winter.

A BELATED PATENT.—A patent issued September 29 to the late O. B. Shallenberger is based on an application filed September 4, 1890, and has for its subject the well-known shunt box, which has been so largely employed in series alternating-current street lighting with incandescent lamps. It is almost ancient history to state that each lamp on the series circuit is placed in parallel with an individual inductance, through which, when the lamp is lighted, only a small magnetizing current passes; while should the filament break, the entire series current will flow through the inductance, the design being such that the e.m.f. then resulting will be practically that which existed between the terminals of the lamp. The original Shallenberger patent on this system was granted October 9, 1888, the present one covering the use of an adjustable inductance whereby on the same constant-current main circuit lamps may be installed requiring a greater or lesser quantity of current for normal operation.

PHASE ADJUSTMENT FOR MEASURING INSTRUMENTS.—A patent granted September 19 in the name of the late Oliver B. Shallenberger, on an application filed January 9, 1897—about a year before the death of Mr. Shallenberger—describes means for producing a given phase displacement between the impressed e.m.f. and the magnetic field of alternating-current measuring instruments. It is well known that by the introduction of self-induction into a circuit an alternating current is caused to lag behind the impressed e.m.f., and that the magnetic flux lags to a corresponding degree; this lag is, however, limited under practical conditions to an amount somewhat less than 90°. For certain measuring instruments it is desirable to augment this angular displacement of the magnetic flux from the impressed e.m.f., so that the flux may be as nearly as possible in quadrature with the impressed e.m.f., or with another magnetic flux having a definite phase relation to the impressed e.m.f. To attain this result a disc of conducting material is in inductive relation with several field coils; one side of the disc is provided with two field coils in series with the main alternating current, and on the other side of the disc there is another field coil in series with an inductance coil and shunted across the mains. A certain portion of this field coil is shunted by a non-inductive resistance. The exact phase relation desired is obtained by adjusting the amount of this resistance and the number of turns of the field coils which it shunts.

COMPENSATING FOR VOLTAGE DROP IN ALTERNATING-CURRENT TRANSMISSION LINES.—A patent was recently granted to Mr. Lawrence A. Hawkins, of Pittsfield, Mass., for an automatic method of compensating for the varying drop in voltage on alternating-current transmission lines due to varying loads and varying power factors; and also for the drop in voltage in alternating-current generators due to lagging currents of varying power factors. For compensating the drop due to a varying power factor, the arrangement consists of stationary coils in series with one phase and a movable coil in shunt with the other phase of a two-phase generator. The movable coil carries an arm which, as the coil revolves, moves over the contacts of a variable rheostat connected to the field circuit of the exciter. A decrease of the power factor in the system causes the movable coil to turn and to cut out resistance from the exciter circuit, so that the generator voltage is raised. The coils of the compensator may not be directly connected with the main circuits, but through intermediate series and shunt transformers. In order to compensate for voltage drop on non-inductive loads, the inventor provides a suitably proportioned choking coil in series with the fixed coils of the compensator. For application in a single-phase system, a condenser is inserted in the circuit of the movable coil. The application of this method is not limited to the generating end of the line. It may also be applied at the receiving end to maintain the excitation of a synchronous motor or rotary converter at a proper value to compensate for lagging current in the mains.

ELECTRICITY IN ALASKA.—Things are moving rapidly in Alaska according to Mr. W. R. Stewart, in the *World's Work* for October. Dawson is lighted by electricity, and has a good telephone system. "The telegraph has far outdistanced the iron horse, and remote corners, as yet long distances removed from any line of railroad, can flash their intelligence around the world. Since 1901 the Signal Corps of the United States Army has put in working order in Alaska more than fifteen hundred miles of land telegraph lines and submarine cables, and in the Canadian territories of the Yukon and North British Columbia the Dominion Government has displayed an equal activity. About two thousand miles of Canadian Government telegraph lines have been built from the international boundary, beyond Dawson, south to Port Simpson and Quesnelle. At the latter point connection is made with the regular commercial lines. Well-equipped telephone services have also been established between the towns, and scarcely a place of five hundred inhabitants in the mining country has not its local and long-distance telephone system."

TURBO-GENERATOR.—A combination steam turbine and polyphase generator is the subject of a patent granted October 13 to E. H. Porter and B. Currier, which involves several interesting features. A multiple set of rotors of an induction generator are carried on the turbo blades, all acting inductively on a stationary armature. This simple type of generator adapts itself particularly well to this type of machine, no insulation being required except the fire and moisture-proof insulation around the armature bars. It is claimed that the losses incident ordinarily with electric generation are in this machine returned to the steam itself, and that the steam, though maintaining in the generator a constant temperature, allows of extreme overloads. The machine is, in fact, so designed as materially to increase in it the ordinary electrical losses, thus maintaining the turbine blades at a slightly increased temperature and thereby avoiding losses due to the condensation of moisture at the turbine blades, this increasing the efficiency of the turbine. This also avoids the necessity of using fine laminations, plate construction being preferable and far less expensive. It is claimed that a machine of this construction and simplicity embodies high efficiency, limited floor space and ease of handling; that it can be started as an induction motor, running in conjunction with other generators, and then by applying full steam pressure, it will take its share of the load; or it can be brought to approximate synchronism by the turbine and simply thrown in without accurate adjustment.

POLYPHASE RAILWAY MOTOR.—A patent was issued October 13 to E. H. Porter and B. Currier on a variable-speed polyphase motor for railway service, in which the speed is varied by varying the number of poles. The motor may be of the usual synchronous or induction type without commutator, supplied by a low-voltage current transformed from a high-tension line current. The stator winding consists of heavy copper bars in multiple, but so connected that each bar or set of bars can be connected by suitable switches to any phase of the supply current; and according to the relative position of these bars with respect to different phases, the number of poles can be varied. These switches are operated by compressed air and controlled by a valve forming part of the motor itself. The valve when operated from the train pipe operates the switches transferring the stator bars to the proper supply, thereby giving any number of poles desired. While if all the switches were thrown at one instant there would undoubtedly be serious burning at the contacts, it is claimed that the transfer of any bar from one phase to another is accomplished without sparking owing to the large number of bars in multiple with it at the time the bar is temporarily removed from the circuit. This is especially true for low-frequency currents for which the motor is designed. It is also claimed that on account of the heavy stator bars and low voltage requiring comparatively light insulation, the temporary variation in the number of bars to each pole and phase during the progressive change of speed will have no injurious effect. The conductors are all in service at all times. A train equipped with motors as described above, by changing the number of poles slightly on arriving on top of a hill, would coast down a grade with a steady speed without brakes and would return the greater part of the energy to the distributing system and other trains. It is intended that the operation of the valves on the different motors which control the switches will be accomplished by the controlling valve at the head of the train, which would be operated entirely by compressed air, thus separating everything in the equipment from the high-tension mains, except the transformers, and thereby insuring perfect safety to the operator.

LETTER TO THE EDITORS.

Tests of Tangential Water Wheels.

To the Editors of Electrical World and Engineer:

SIRS:—We note in your issue of August 29, page 349, a letter addressed to you by Mr. George J. Henry, Jr., chief engineer of the Pelton Water Wheel Company, referring to an article in your issue of June 20, page 1071, entitled "Efficiency Tests of Tangential Water Wheels under 1,912 ft. Effective Head."

Mr. Henry states in this letter his opinion that the impression produced on a reader of this note might be that the Pelton wheel was lacking in efficiency, whereas an efficiency of 86.2 per cent. was shown in efficiency measurements made by "independent engineers." We fail, however, to find the Pelton wheel mentioned in the note to which Mr. Henry refers, and as far as its efficiency is concerned we refrained from taking this up in our communication to you of June 5, from which you made up your article, because the Pelton Water Wheel Company were not willing to enter any comparative test, although we had tried all inducements, and the Edison Electric Company had made arrangements for such a test.

The only comparative test by "independent engineers" at the Mill Creek plant was made on the 16th and 17th of April, 1903, namely by Prof. Hoskins, of Stanford University, and Messrs. Samuel Storrow and William H. Sanders, both consulting engineers of Los Angeles, who found a maximum efficiency of the Pelton wheel of approximately 80 per cent. at its most favorable load during a three-hour run.

This test was carried out most carefully, and every precaution was taken to make it as reliable as possible. The weir was checked up by both engineers, the leveling instruments were tested and five minute readings were taken throughout the entire range of the test. The water measurements were taken with very accurate hook gauges with the verniers reading to one-thousandth of a foot, and two hook gauges were used. The measurements were verified by all three engineers. At its most favorable point the Pelton wheel showed a lower efficiency than the Doble wheel. At points of partial load its efficiency was much lower. Although the specifications required that both wheels should carry an overload of 20 per cent. (the generators are 750 kw) the greatest load that the Pelton wheel would carry was under 780 kw, while the Doble wheel carried an output on the generator of 1,200 kw delivered to the switchboard. Even when carrying this great overload, the Doble wheel exceeded the efficiency of the Pelton wheel at its most favorable point. This test we regarded as merely preliminary, because the indicating wattmeters were not dead-beat and their accuracy was not known. Therefore, we have not published the exact results. This will be done when a final test is made before the close of the year.

The test made on the Pelton wheel, from which an efficiency of 86.2 per cent. was arrived at, was not made, as Mr. Henry states, by independent engineers, but by Mr. Henry himself with the assistance of Prof. Le Conte, of the University of California, in the following manner, which speaks for itself: The two gentlemen arrived at the plant without having provided a hook gauge to measure the water. Accordingly they had to improvise one, and they constructed what the chief engineer of the Power Company called a "shark hook." The hook is made of 3/8-in. round iron, is 6 in. across, and was pointed on an emery wheel. It is fastened on the end of a long staff, and the observer stood on a platform 6 ft. above the surface of the water. In getting the base line on this measuring staff from the edge of the weir (for this independent test) Mr. Henry, of the Pelton Company, sighted the level. The rod was simply a redwood stick with a pencil mark on it, transferred from the edge of the weir to the point of the hook without plumbing it. The base line on the stem of the "shark hook" was a knife cut, and the readings were taken off by measuring from a knife cut on the wooden pole to which the hook was attached at the lower end. The value of this test can be best appreciated when Mr. Henry pretends to announce the results down to tenths of a per cent. It was like measuring millimetres with an unmarked yardstick.

During the test made by Messrs. Hoskins, Storrow and Sanders

very careful observations were made to guard against leakage around or under the weir, which is most important, as such a leakage would, of course, make the apparent efficiency materially higher than the actual one. The first thing done by Mr. Henry and Prof. Le Conte was to open up the bottom of the weir and let the water out of the measuring pond, so that the conditions, under which they conducted their test, were entirely different and must cast discredit on their results.

The weir was 8 ft. in width, and the small quantity of water going over this wide weir crest made the most accurate measurements of the height of the water of the greatest importance, as an error of a thousandth of a foot in reading this height would materially affect the percentage secured.

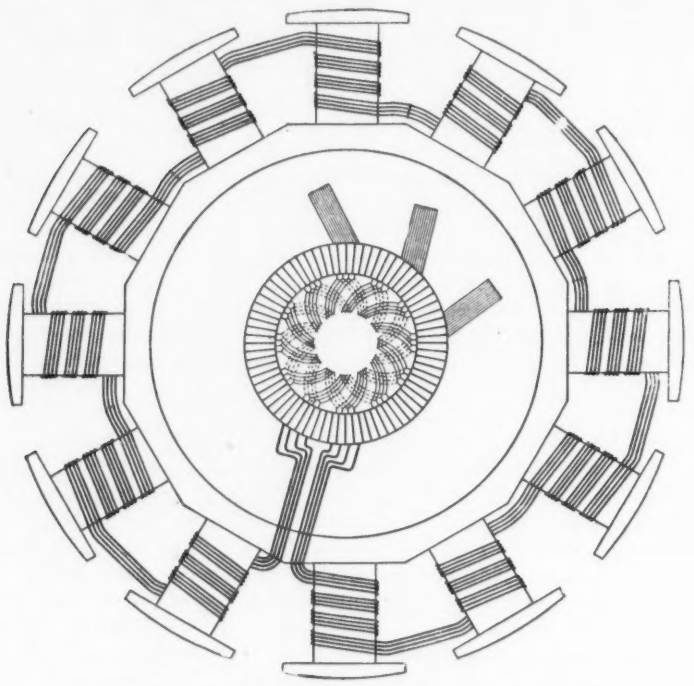
As to Mr. Henry's statement that the Edison Electric Company's orders for other wheels were placed before competitive measurements were made, and before the plant was put in service operation, we can only say that the tests were made on the 16th and 17th of April, 1903. The written order for the last wheel unit of this plant is under date of May 9, 1903. His statement, though also misleading, is accurate in that there have been no competitive tests properly speaking.

San Francisco, Cal. H. Homberger.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Compensation and Compounding of Alternating-Current Machines.—Heyland.—The author refers to the article by Meyer, recently noted in the Digest, and states that he concurs with the latter's opinion that the application of compensated non-synchronous machines, when they are motors, can be considered only in special cases. But he calls attention to the fact that for a long time he (the author) has advocated compensation and compounding of non-synchronous machines not so much for motors as for generators. The most interesting item in the further development of his compounded machines is the fact that these latest machines will be synchronous machines of the revolving magnet pole type. In explaining the principle of his new synchronous machine, he compares the rotor windings of synchronous and non-synchronous machines and shows that the mean length of a coil of the rotor winding of a non-synchronous machine averages at least twice as long



COMPENSATION OF ALTERNATING-CURRENT MACHINES.

as the mean length of the winding on the field pole of a synchronous machine with solid poles and an equal flux per pole. If it is assumed that the rotor of such a non-synchronous machine be wound for two-phase working, then the field, according to its momentary direction in the rotor, will be produced alternately by the one or the other of the two phases, and at the moment when the one phase has full current, the other phase has no current. If it is imagined now that the machine rotates in synchronism (which may happen, at times, with compound non-synchronous machines), and further, that this takes place at the moment when one of the two phases has full current, it will be seen that the other phase remains continually without current and might be left out entirely without increasing the losses in the least. The new machine, which is illustrated diagrammatically in the accompanying figure, is the outcome of these reflections. The slotted rotor is replaced by a magnet wheel, and instead of a two or multi-phase winding, this magnet wheel is provided with an ordinary simple pole winding, which (as in the case of the rotor phases of the non-synchronous machine) consists of several wires wound in parallel and connected to the commutator in a similar manner. The connection of the pole winding to the commutator does not correspond quite exactly to the connection of the phases of the non-synchronous rotor, but the indications given above give quite a good idea of the principle underlying the new machines. The phenomena which occur in these synchronous machines are somewhat different. The commutator serves in the first instance for splitting up the compounding current into two components, a power current and a wattless current, the latter only by reason of the brushes being properly spaced, being conducted to the active pole winding. On the other hand, the power currents which enter the winding flow in opposite directions through the various parallel-wound wires, thereby neutralizing each other. The parallel-wound wires are connected to the commutator in such a manner that the brush currents are not interrupted in any position, and that at interruptions of the current in the various wires the effect of the self-induction is neutralized by the remaining parallel circuits. By means of certain cross-connections between the various wires it has, in addition, been made possible to avoid any sparking at the commutator, even when employing relatively high voltages at the brushes. Considering the use of the machines as motors, the author states that the former non-synchronous rotors may be retained, but with a single-phase winding only. This represents the pole winding, and is connected to the commutator in the same way as described above; the slots in the middle of the winding may be omitted or filled up with iron, so that in this way the pole section is correspondingly increased. At starting this single-phase winding is used as starting winding by cutting the winding in the center, and, as is the case with non-synchronous motors, completing the circuit through slip rings and starting resistances. Such a motor starts with a large torque, similar to a non-synchronous motor which is fitted with a three-phase rotor having one phase open and the rotor winding short-circuited on itself through two slip rings only. The starting of such a machine is comparatively simple, requiring only two slip rings and a simple single-phase starting resistance. When running the single-phase winding serves as a pole winding, as in the case of the generators. The machine must be somewhat over-compounded and when the brushes are in their proper position it automatically speeds up to synchronism. If sufficiently over-excited, these machines, when working as motors, need not be overcompounded. The curve of the power factor will be similar to that of an ordinary non-synchronous motor. The new machines will be used chiefly as generators of the magnet wheel type.—Lond. *Elec.*, October 2.

Parallel Working of Alternators.—Hopkinson.—A paper read before the recent meeting of the British Association for the Advancement of Science. The author proposes to co-ordinate the mathematical treatment of the subject with the practical rules which have been framed and are regarded as standard practice, and to

point out the reason for certain phenomena which have been observed. He investigates mathematically the free oscillations which are executed by an alternator when disturbed by a temporary change of conditions, and the forced oscillations which are produced in the alternator by the uneven turning moment in the prime-mover. The possibility of parallel working, therefore, depends on the free oscillations being damped out within a short time of being set up and on the forced oscillations being of such moderate amplitude as not to interfere with the practical working. In discussing the forced oscillations, the author points out that the limitation of the angle by which the machine deviates from perfectly uniform rotation, is not precisely what is needed, and that it would be better to limit the amount of fluctuation in the rate at which energy is delivered by the machine to the bus-bars. As the speed is practically constant, this is proportional to the variations of the torque; hence, a machine with small self-induction will operate worse in parallel under a given amount of angular displacement than another one of large self-induction, supposing the condition of a long natural period to be fulfilled. The author states that the ordinary rules as to fly-wheel effect generally result in the natural period of oscillation being substantially greater than the period of revolution of the engine, but in a somewhat roundabout and accidental way. It seems highly desirable to pay more attention than has hitherto been usual to the natural period of oscillation of the alternator, when specifying fly-wheels. The period of oscillation of the governor of the engine should not be lost sight of; this is generally fairly long and may possibly give rise to resonant oscillations. He mentions the case of a motor generator, which could not be worked on account of resonance. Its natural period happened to be very nearly equal to that of the revolution of the generator, about two-thirds of a second, and it dropped out of step in a very short time, though the variation in turning moment must have been quite small. By altering the field current so as to increase the natural period about 25 per cent., the forced oscillations disappeared almost completely, showing that the difficulty was entirely due to resonance. This fact suggests the reflection to the author that it might possibly be better in some cases to put fly-wheels on the comparatively high-speed rotaries, and allow a small fly-wheel and a larger angular deviation in the slow-speed generators. He then investigates the question of free oscillations and the production of a damping effect by the "amortisseur" action. In conclusion, he states that "to sum the whole matter up, the proper way to deal with forced oscillations is to use the right fly-wheel, while damping coils must be used for giving stable free oscillations."—Lond. *Elec.*, September 18.

POWER.

Three-Phase Motors for Electrical Driving.—EBORALL.—The conclusion of his article, previously noted in the Digest, on the application of three-phase motors to the electrical driving of workshops and factories. The author gives a number of tables for various classes of machine tools, such as lathes for different purposes, boring, milling, drilling, etc., machines, showing the size of motor required, it being understood that the motors in question can carry overloads of at least 50 per cent. continuously. The author thinks that it pays, in fact, to use motors which are a little too small for the work, as they will then always be working on the flat position of the efficiency curve, and hence with maximum economy. For traveling crane work the author regards as the best practice using slip ring motors in all cases for the lifting motion, and if the motor is above 4 hp in size, also for the longitudinal motion of the crane, in order to have perfect control of the working of the crane. On the other hand, the motor for the cross-traverse of the crab can invariably be arranged with a permanently short-circuited rotor. The author next considers the application of the three-phase motors to textile mills and thinks that they meet the various requirements of the case better than direct-current motors can do, whether driving in groups or independently. He states that the ordinary loom in the silk-weaving industry actually requires about 0.25 hp to drive it, corresponding to 0.3 hp at the motor pulley. As a special point he lays emphasis on the fact that experience has shown that a belt connection between the motor and the loom is far preferable to any other form, like spur gearing, for instance, and he thinks it can only be a question of time before silk looms are universally electrically driven in this way.—Lond. *Elec.*, October 2.

Electrically-Operated Mine Haulage Plant.—A description of a recent installation at a German mine. The power station is at some distance and generates electricity for another mine also. There are two 500-hp engines direct-coupled to 300-kw, three-phase generators, which furnish current at 2,080 to 2,300 volts. A suitable fly-wheel keeps the cyclic irregularity down below 1/250th. Exciting current is furnished by two motor generators, one serving as reserve. Direct-coupled to the 20-hp, three-phase motor is the shunt dynamo, generating exciting current at 125 volts. The starting resistance of the three-phase motor is lodged in the armature. Six single-phase and three larger sized three-phase transformers of a total capacity of 295 kw, reducing the pressure from 2,200 volts to 220 and 110 volts, respectively, are used in connection with the lighting system and for the operation of the small auxiliary motors. Three-phase current is transmitted by a three-cored armored cable, 2,200 metres long, to the motor which drives the haulage plant. The latter is of the induction type, with 12 poles, and has a normal output of 120 hp, which may be exceeded by 100 per cent. for short periods. Current is supplied directly at 2,000 volts. The induced voltage in the rotor is about 500 volts. Slip rings are provided for starting and for speed regulation, the resistances being of the spirally-wound wire type. The "reversible starter" is so arranged that any one of the connections can be effected by a single lever. In the center position of the latter two phases of the motor circuit are opened and the motor stopped. By moving the lever in the one or other direction, the motor begins to rotate in that direction. The efficiency of the motor is 92 per cent. and the power factor at full load 0.9. The total efficiency of the haulage plant is about 72 per cent. The total steam consumption per hour of the plant amounts to 2,800 kgm., while a steam engine suitable for dealing with the same haulage requirements would consume about 4,500 kgm. The difference in favor of the electric plant is, therefore, about 38 per cent., meaning at the coal prices in that particular locality, a saving of about 58 cents per hour. The machine is capable of safely hauling a net load of 1,800 kgm. from a depth of 450 metres at a speed of 3 metres per second.—Lond. *Elec.*, September 25.

Electric Coal Cutting.—THOMAS-DAVIES.—An abstract and analysis of a paper by Walker on this subject, read before the Nottingham meeting of the Institution of Mining Engineers. The paper refers to practical experiences with electric coal cutting at the Digby Colliery Company. The difficulties encountered with electric cutters under the peculiar conditions at this colliery are discussed at length. When cutting to the dip with a 4½-ft. tapered bar, and making an undercut of from 3 ft. 8 in. to 4 ft. 2 in., the energy consumption measured near the dynamo was on an average about 2 kw-hours per square yard of holing. When cutting to the rise, using a 4-ft. taper bar with cleaning blade, and when using a 4½-ft. taper bar without the cleaning blade, the average consumption was in both cases 1.33 kw-hours per square yard of holing; cutting to the rise with a 4-ft. taper bar, with cleaning blades, the consumption was 1.22 kw-hours, while the 4-ft. parallel cutter, traversed to the rise, consumed on an average about 1 kw-hour per square yard of holing. About 75 per cent. of these figures would give the consumption of electrical energy at the motor.—Lond. *Elec.*, September 25.

REFERENCES.

Efficient High-Pressure Water Power Plant.—HENRY AND LE CONTE.—A description of the hydraulic features of the hydraulic power plant which has recently been started in Southern California by the Edison Electric Company, of Los Angeles. The Pelton water wheels and the method adopted for their regulation are described, and efficiency curves are given from which it appears that the efficiency of the wheel exceeds 86 per cent., including the losses in the gate valve and nozzle, the windage of the wheel and such slight losses as occur in the buckets. The results of tests undertaken for the purpose of determining the efficiency of the wheels for different loads and styles of nozzle tips, are also given.—*Eng'ing News*, October 8.

Congress of "Houille Blanche" in France.—BLOCH.—The conclusion of his article previously noted in the Digest. The present installment describes the utilization of water power in France and an illustrated description is given of the installation of Aristide Berges at Lancey, in the French Alpine regions. The power is obtained from a head of water of about 470 metres and current is furnished to a paper factory, to a system of lighting with a 12,000-volt line 44 km. long, and to a tramway 43 km. long. The installations are comparatively small, as the country is not thickly populated. —Lond. *Elec. Rev.*, September 25.

Electric Pumping for Irrigation.—KILBURN SCOTT.—A short review of the advantages of this method, as exemplified in the well-known Bakersfield (Cal.) plant which has been described in ELECTRICAL WORLD AND ENGINEER.—Lond. *Elec. Rev.*, September 25.

Electrically-Driven Milling Machines.—A short illustrated article, giving examples of some recent construction in milling tools driven by electric power.—*Am. Machinist*, October 8.

TRACTION.

Moulineaux Electric Power Station, Paris.—ALLEN.—An illustrated description of this station, which is owned by the Compagnie des Chemins de fer de l'Ouest, and supplies power for the suburban stretches of railway, extensive tramway systems, numerous cranes, machine tools and pumps, and to outside customers. The station is fed with steam from 27 boilers. It contains nine main generating sets, each consisting of a triple-expansion or compound horizontal engine directly coupled to an alternator of 800 to 1,000 kw output. The maximum output of the station is 9,900 kw. The generators are of the three-phase type, with rotating fields, running at 78 to 80 r.p.m. The field magnets carry 38 poles, giving a frequency of 25 cycles. The efficiency of the generators is stated to be 94 per cent., at a load of 800 kw, the power factor being 90 per cent. Current is generated at 5,000 volts and is transmitted to three sub-stations, where it is converted into direct current at 500 volts for distribution to the railways, etc. There are four exciter sets, each consisting of a single-acting compound engine coupled to a multipolar dynamo of 125 kw output at 125 volts. The exciting current of each of the alternators is 175 amp. at no load and 195 at full load at 110 volts. The switchboard arrangements are very complete, there being a separate panel for each alternator and exciter, and five feeder panels. The high-pressure circuit-breakers are fitted at the top of the panels; they are of the long break type and are separated from each other by large marble barriers, which effectively prevent arcing from one pole to another. Each of the switches has a capacity of 100 amp. at 5,000 volts.—*Engineer*, October 15.

Electric Narrow Gauge Road Between Lausanne and Moudon.—An illustrated description of the transformer stations and the rolling stock. Polyphase current of 8,000 volts at 50 cycles is furnished to the transformer stations, each of which contains two motor generator groups of 200 hp each, one serving as reserve. One of the aggregates is driven by a non-synchronous and the other by a synchronous motor, on account of the necessity of furnishing lighting and traction current from the high voltage line. If no light is needed, the non-synchronous transformer is working, as it is less sensible to the varying demands of current or overloads than the synchronous motor. Both motors are for 8,000 volts and wound for 12 poles; they run at 500 r.p.m. The shunt machines which are directly coupled to these motors generate 750 to 900 volts direct current. One of the sub-stations contains a buffer battery of 385 cells, with 165 amp.-hour at one hour's discharge. The double-truck cars are furnished with four four-pole motors of 35 to 50 hp. Each two of these motors are connected in parallel at the start, while all of them work in parallel, when the car is running. The characteristic curves of the car motor are given in an illustration, as is also the arrangement of the controller connections for a single-truck car.—*Elek. Zeit.*, September 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Three-Phase Switch Gear.—EBORALL.—The author discusses the construction of high-pressure polyphase switch gear and states that he is unable to agree with those engineers who consider that the cellular and backless type of switchboard is superior to all other constructions for use in connection with high-pressure polyphase systems. He considers that while such boards give excellent results in connection with single-phase work at moderate pressures, their sphere of utility is limited to single-phase, single-pole working at pressures not exceeding 3,000 volts. The adaptation of the cellular board to pressures of the order of 10,000 volts appears to the author an example of a good thing being carried too far. High-pressure switchboards, according to him, in order to attain safety, convenience and absolute reliability in working, must be constructed upon the following lines: 1. The whole of the high-pressure gear must be removed from the operating platform and isolated in fire-proof compartments below, above or at the back of the platform upon which the operating board is placed. This means the remote control of the high-pressure apparatus, which the author considers the essential feature of high-pressure, three-phase boards for controlling large amounts of energy. The only apparatus on the operating board should be that required in connection with the exciting arrangements, and in connection with the control of the distant high-pressure gear, and the measurement of the current, energy, etc., of the distant machine and feeder panels. 2. All high-pressure fuses should be done away with, as far as those in main circuits are concerned. These should be replaced by automatic attachments on the main switches; that is, the latter are to be simply automatic circuit-breakers, which open at definite overloads or (if fitted with reverse-current attachments) with reverse currents. Protective devices in the separate generator circuits should be fitted with time or with reverse-current attachments, or both; otherwise they should not be used. 3. The high-pressure bus-bars should be arranged in such a way that any portion of them can be isolated for cleaning while the remaining portions are alive, without interrupting the supply. Further, their arrangement should be such that any panel can be cut completely out of circuit without interrupting the supply, if necessary. 4. The high-pressure bus-bars should be provided with properly arranged pressure dischargers, while similar dischargers should be used at the far ends of the feeders, and where practicable en route. 5. The whole arrangement of the low-pressure operating board should be such that the attendant has no excuse for getting confused in case of a break-down, which necessitates prompt measures being taken at the switchboard. 6. The whole arrangement of the high-pressure gear proper should be such that arcing from one part to another, or to earth, due to an accident, or to abnormal conditions, is rendered an absolute impossibility. Nothing should be cramped, plenty of space being allowed everywhere, with each piece of apparatus in plain view for inspection, and capable of easy dismantling or removal for repairs or renewal. 7. The whole of the high-pressure gear should be in oil, as far as it is possible to arrange this. The author then examines how these requirements are complied with in the best practice of to-day, and gives a dimensional sketch of a simple form of remote control board with the actual connections, which is described in detail and its advantages set forth. The construction of a cellular switchboard is also illustrated and the disadvantages and difficulties encountered with this type for really heavy polyphase work are discussed at some length, in order to justify the author's opinion, that it can only be a question of time before it disappears in favor of the "remote control" design of board.—*Eng'ing*, September 25.

Central Station Auxiliary Plant.—DAVIES.—The author considers in detail the arrangement of the auxiliary plant in central stations, such as the pumps, injectors and stoker and economizer gear. The pros and cons of electricity versus steam for the driving of pumps are taken up at some length. The author comes to the conclusion that, taking everything into consideration, it appears that the best method is to install both steam and motor pumps. The latter should do the bulk of the work on heavy load, and should be kept running at constant speed and as nearly at full load as possible, while the steam pump should be used simply for the small regulations that are constantly necessary, and for very light load. The installation of both sorts of pumps is also advisable as a safeguard against break-down of the steam or electric service. As feed pumps are such important items in the safety of a station, this precaution is necessary. The same procedure, namely, the installation of both steam and motor drive, is recommended for the stoking gear, the steam plant being looked upon chiefly as a stand-by. The author considers it best, when possible, to drive the economizer scraping gear from the stoker plant; but if the latter is not installed, or is too distant, motors alone should be used, as the steady load at constant speed allows them to run under excellent conditions. The author's opinion is that the practice in single-phase, alternating-current plants, of driving the auxiliaries by direct-current motors supplied from the exciter circuit, while allowing a gain in efficiency, is very liable on account of the risks attendant upon it, to cause that efficiency to be bought at too great a price, namely, in convenience in working or perhaps failure of supply, as the slightest interruption or unsteadiness of the exciting current will often lead to complications when alternators are in parallel. The carrying of loads from this circuit into all sorts of out-of-the-way places is, therefore, highly dangerous and the practice is obviously bad.—Lond. *Elec. Rev.*, September 25.

Protective Devices for High-Tension Electrical Systems.—WOODHOUSE.—A paper read before the recent meeting of the British Association for the Advancement of Science. The author discusses several points in connection with the operation of a high-tension poly-

phase transmission system, as to the design of the system and the stresses on it. He then deals with circuit-breakers, fuses, switches, overload relays, reverse-current relays, devices which prevent or relieve excessive rise of pressure and switching inductive apparatus. Under the head of fuses he gives the results of tests of several types in the form of curves in which the time taken for the fuse to blow after the application of a definite overload is marked as a point on the curve. It appears from them that the Ferranti type of fuse blows almost immediately after the current reaches the fusing value, whatever be the magnitude of the overload. The long fuse on the contrary takes many seconds to blow on a moderate overload, and an appreciable time even on a heavy overload. The one, therefore, has no appreciable time lag and the other has too much on heavy overloads. The author states that the practice is increasing of attaching an automatic relay to the switch and dispensing with the fuse altogether. Under the head of switches he describes and illustrates several recent types of European make.—Lond. *Elec.*, September 25.

ELECTRO-PHYSICS AND MAGNETISM.

REFERENCE.

Vaporization and Boiling of Metals.—KRAFFT.—An abstract of a paper giving the author's results in investigating the boiling points and vaporization points of metals when heated under a high vacuum in the electric furnace. The author used fused quartz vessels for carrying out his experiments and worked at temperatures of about 1200 to 1400° C.—*Zeit. f. Electrochem.*, September 17; from *Berichte Deutsch. Chem. Gesellschaft*, 36 p. 1690-1714.

ELECTRO-CHEMISTRY AND BATTERIES.

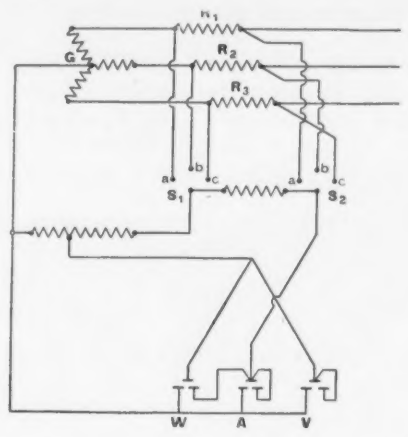
Elmore Copper Process.—An illustrated article in which the well-known Elmore process for the manufacture of copper tubes is briefly described. The illustrations shown refer to the German Elmore works at Schladern, which make use of 400 hp from steam and 550 hp from water power. These works produce some 2,600,000 pounds of copper per year, while the total weekly capacity of all three works, Schladern (Germany), Leeds (England) and Havre (France), is stated to be about 396,000 pounds. It is stated that the current density at the cathode amounts to 56 amp. per square foot, and that the deposition of a copper tube four to five mm. thick takes a week.—*Electrochemist & Metallurgist*, September.

REFERENCE.

Polishing and Plating of Metals.—HAWKINS.—A continuation of an extract of a manual on the above subject. The author discusses the arrangement of plating shops, the kinds of dynamos to be used for electroplating and the troubles due to the prevalent ignorance of electroplaters on the subject of electricity. In his opinion a greater current density can be used if the thickness of the cathode is greater, and an attempt is made to explain the reason, which he believes is due to the better heat conductivity of the thicker cathode. —*Am. Jeweler*, September.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrostatic Wattmeter.—ADDENBROOKE.—A long article in which the author deals with the electrostatic wattmeter, its calibration and adaptation for polyphase measurements. He first discusses the theory of the action of the wattmeter when coupled to circuits, and describes at considerable length the means by which it can be standardized and calibrated. The needle and one pair of quadrants are connected to the terminals of the circuit between which the voltage is to be measured. Between the connections to the two pairs of quadrants there is inserted a fixed resistance, through which the main current passes; hence, the difference of potential between the two serves to measure the current. The deflection of the needle being produced by both of these quantities is a measure of their product, namely, watts. To obtain all the factors required in measuring an alternating circuit containing inductance and capacity, the author employs, in addition to the wattmeter, a voltmeter and an ammeter. The two-phase measurement with two separate circuits is simple and resolves itself into two separate measurements. Two-phase measurement with a common third wire is best managed by putting resistances in each of the outer wires to enable the current flowing in each circuit to be measured separately, while the pressure connection for the voltmeter and wattmeter is made to the common return. To carry out measurements in this manner a switch has been worked out which enables all the instruments with the high resistance across the circuit, to be thrown over from one circuit to the other almost instantaneously. The adjoining figure shows the arrangements for measurements on three-phase circuits, where the working of each circuit can be completely separated from the others. *G* is the generator, *W*, *A* and *V* are the electrostatic wattmeter, ammeter and voltmeter, respectively, each indicated by three short lines, the upper one representing the needle and each of the lower ones a



ELECTROSTATIC WATTMETER.

pair of quadrants; S_1 and S_2 are the switches. If the center of the star in the star connection cannot be got at, an artificial zero made by connecting three equal resistances radiating from a center and joined to the three phases, may sometimes be used with advantage. To obtain the elements of a delta-connected circuit, it is well to proceed in the manner proposed by Dr. Fleming in his handbook. The author states in conclusion that he has shown sufficiently on what a simple logical basis the making of electrical power measurements by means of electrostatic instruments rests.—Lond. *Elec.*, September 4, 11.

Capacities in Connection with Electrostatic Voltmeters.—MARCHANT AND WORRALL.—A paper read before the recent meeting of the British Association, on the use of capacities as multipliers, in connection with electrostatic voltmeters on alternating-current circuits. The authors describe experiments directed to the construction of a simple and easily made apparatus, by which low-reading electrostatic voltmeters may be employed on circuits of much higher tension. The voltmeters used were of the Kelvin multicellular and Ayrton and Mather electrostatic types. The method of combining the voltmeter with the capacities is to connect a capacity in series with the voltmeter across the mains and shunt another capacity across the terminals of the voltmeter, the latter capacity being large compared with the capacity of the voltmeter. The reading of the latter bears a constant ratio to the P. D. between the mains, and by varying the capacities any desired ratio may be obtained. Compactness and saving of material are gained by forming the two capacities into a condenser, in which one of the two sets of plates is itself divided into two groups, each group connected to its own related main, one group to the voltmeter and the voltmeter again to the undivided set. Two instruments are briefly described and illustrated in which those principles are embodied, one for measuring P. D.'s up to 300 volts on a 150-volt instrument, and having a ratio of ½, and the other for P. D.'s up to 10,000 volts, with a ratio of 1/40. The low-tension instrument is formed of alternate sheets of mica and tin foil of equal dimensions, held together between strong plates of ebonite. The high-tension instrument is similarly formed, except that copper foil is substituted for tin foil, the dielectric varies in thickness directly with the tension and the whole is damped between brass plates. The dielectric plates in the higher tension portion are made larger than those in the lower tension portion to avoid sparking over the surface and the entire instrument is suspended in oil for the same reason. Results of experiments for testing the accuracy of the instruments are given, the existing variations being well within the limits of experimental error. The authors hope that this device may be of considerable practical utility in simplifying the construction of high-tension voltmeters and in laboratory and experimental work.—Lond. *Elec. Eng.*, September 18.

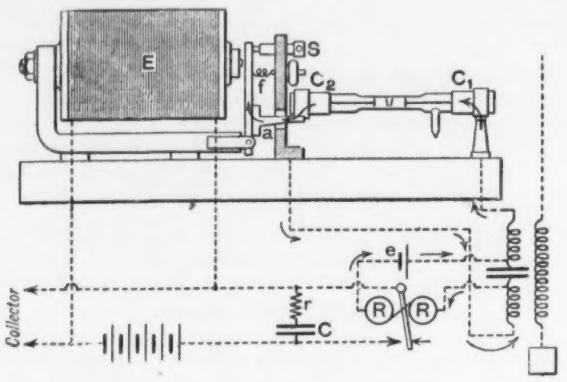
REFERENCE.

Measurement of Cable Capacity.—FLEMING.—An extract from a forthcoming book on testing. The cases of two-core, three-core,

etc., cables and concentric cables are mathematically investigated.—Lond. *Elec.*, September 11.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Selective Wireless Telegraphy.—ANDERS BULL.—The author gives the results of experiments conducted with his system of wireless telegraphy, previously noted in the Digest. The stations were 55 km. apart, the experiments being conducted with the sole view of proving the possibility of secretly communicating between stations and of the further possibility of sending messages by means of selective telegraphy to several independent receivers at the same time. The author's arrangement, embodying his improvements, is



SELECTIVE WIRELESS TELEGRAPHY.

shown in the adjoining figure. One pole, C_1, of the coherer is fixed, the other pole, C_2, being connected by means of a bracket, *a*, to the armature of the electromagnet, *E*. This armature is pressed by an insulated spring, *f*, against a screw contact, *s*, which limits the movement of the armature in the one direction and serves at the same time as contact for the coherer current. On the coherer becoming conductive, the current, supplied by the battery, *e*, flows as indicated by the arrows. The relay, *R*, being magnetized, causes the closing of the secondary circuit, in which are placed the collector magnet and the electromagnet, *E*. As soon as the armature of the electromagnet begins to move, the relay current is interrupted and its switch has time to go back to the off position before the coherer has ceased to vibrate. Since the coherer is tapped twice, first on the armature striking the core of the electromagnet, *E*, and second on the armature coming in contact with *s*, the decoherence is most complete, vibrations after the shocks being almost entirely absent. The armature movement need not exceed 0.1 mm. To avoid the formation of local sparking, condensers, *c*, were used, in series with which resistances were placed for diminishing oscillatory discharges. At first the tests were not successful, due to the fact that the capacity of one end of the coherer was augmented by that of the electromagnet, *E*, with the result that the potential differences, caused by the oscillations, were decreased. After the necessary alterations had been made, the tests are said to have proved satisfactory.—Lond. *Elec.*, October 2.

New Books.

SECONDARY BATTERIES. A Practical Handbook for Owners and Attendants. By an Engineer. London: H. Alabaster, Gatehouse & Company. 77 pages, illustrated. Price, 4 shillings.

The enormous growth in the use of accumulators during the last decade is reflected in the increasing literature of the subject. The present volume, which is small and unpretentious, is, we believe, the first one of recent date to treat the subject from a purely operating standpoint. Written by a "practical" man, the treatment is decidedly elementary and the author presupposes but little electrical and no battery knowledge on the part of his readers—a good point, considering the class of men he aims to reach.

The faults are largely sins of omission, conspicuous among which is the failure to describe the use of the cadmium auxiliary electrode, now so universally used, at least in this country. Boosters are dismissed with a paragraph or so, and no description given of their various uses, while only the simplest form of end-cell switch is described.

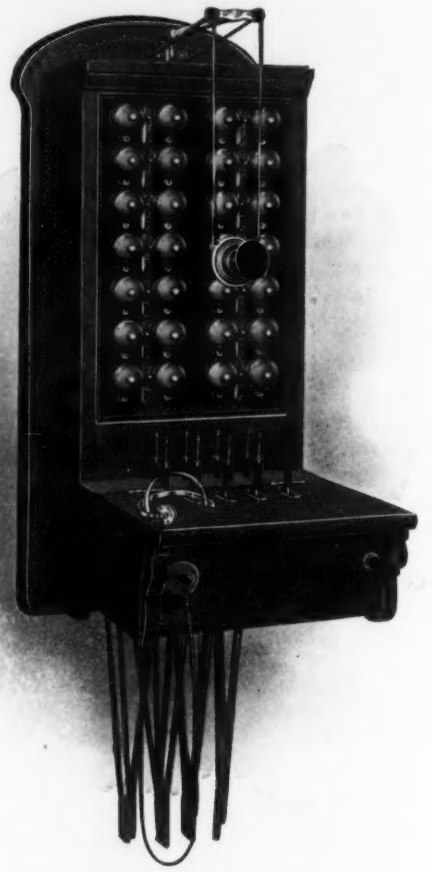
The arrangement seems not very logical, and more headings would be an improvement, though the lack of them is partly offset by a fairly complete index. Most of the advice given is sound, although some things apply only to English practice, and are of little use here. The appendix gives a number of useful tables, though several of these, too, would not apply in this country.

Taken as a whole, an engineer in charge of a small lighting or isolated plant, who has batteries to look after "on the side," might find here many useful hints; but for the care of large railway and lighting stations, the application would be decidedly limited. The care of automobile batteries is not touched upon.

Village Telephone Exchange Switchboard.

It has recently been pointed out in these columns how interesting and important is the development of rural or village telephony, this movement having gone so far already that one of the members of the United States Senate, Mr. Fairbanks, has proposed to modify the existing postal arrangements, so that the local postmaster can send special delivery telephone letters to farmers and remote dwellers in the rural districts by using the local telephone system.

A good deal of this new work is due to the energy and initiative of manufacturers in the independent field, some of whom have devised apparatus at once simple, durable and economical. An illustration of this fact is to be found in the illustration furnished



VILLAGE TELEPHONE EXCHANGE SWITCHBOARD.

herewith of the village exchange switchboard constructed and furnished by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago and Rochester, N. Y. This party line switchboard has each of the lines terminating in a spring jack and a polarized ringer signal. This board is intended especially for party line operation in rural districts, and is equipped with operator's telephone, hand generator, connecting cords, plugs, keys and all the necessary apparatus. The operation of such a system is obviously well within the capacity of persons of intelligence, even if they have no mechanical inclinations, and it has been found that little or no trouble is experienced in securing locally the talent necessary to carry on such systems successfully.

Exhibits at Ohio Electric Light Convention.

The meeting at Columbus last week of the Ohio Electric Light Association was largely attended by representatives of electrical manufacturers and supply dealers, and the following exhibits were displayed:

THE GENERAL INCANDESCENT ARC LIGHT COMPANY exhibited its multiple and alternating and direct-current lamps in operation, and series alternating-current arc lamps in both shunt and differential types; it also showed a new knife switch, an automatic switch for remote control and a Wright demand meter. Emphasis was placed on the special feature of its 110-volt, direct-current lamp, consisting in an adjustment coil permitting change in adjustment from 3 amp. to 6 amp.

THE J. A. ROEBLING'S SONS COMPANY made no display, but distributed souvenir wire gauges, which were in great demand.

THE W. G. NAGEL ELECTRIC COMPANY, of Toledo, exhibited the Nernst lamp in operation in various sizes.

THE GENERAL ELECTRIC COMPANY had a special display of its new "Meridian" lamp, in competition with the Nernst lamp. It also showed a Christmas tree outfit, which attracted much attention, and had on view its concentric light diffuser with photographs illustrating the soft, even light, free from distinct shadows which this attachment insures.

THE STANLEY ELECTRIC MANUFACTURING COMPANY showed its line of meters in operation.

THE BRYAN-MARSH COMPANY had on exhibition its new type lamp, burning out at the 80 per cent. line of initial candle-power.

THE EXHIBIT of arc lamps by the Adams-Bagnall Electric Company, of Cleveland, handled by the Electric Appliance Company, of Chicago, was very complete, and attracted a constant throng of callers—the lamps made a fine appearance, the cases being of copper and constructed with interchangeable parts, the insulation being very thorough. Here were also shown the Gutmann wattmeter, the Packard incandescent lamp and Packard transformer.

THE NATIONAL ELECTRIC COMPANY, of Milwaukee, successors to the Christensen Engineering Company, showed by means of enlarged photographs its various types of direct and alternating-current generators and motors, belt-driven and engine type, of various designs. Its representatives also gave away handsome steel tape measures to all callers.

The above were all the regular exhibits, but the traveling men from the other houses represented were ever present and made up in personal interviews what they lacked in material and physical exhibits. A theatre party Tuesday night was given by the Erner-Hopkins Company, the Columbus Railways & Light Company, and the General Electric Company.

SUPPLY MEN IN ATTENDANCE.—Adams-Bagnall Electric Company, W. V. Orr, Cincinnati; F. L. Druliner, Cleveland; American District Steam Company, H. B. Kimbrough, Chicago; Bryan-Marsh Company, F. H. Haughton, F. W. Godfrey, Cincinnati, Ohio; Buckeye Electric Company, R. M. Barwise, Cleveland; R. N. Hemming, E.E., Columbus; Babcock & Wilcox Company, W. D. Chester, Pittsburg, Pa.; F. Bissell Company, C. M. Hamilton, Toledo; Bruce Electric Company, Columbus, Ohio; Crocker-Wheeler Company, H. A. Brown, E.E., Chicago; Hart Manufacturing, William Crichton; Doubleday-Hill Electric Company, C. P. Hill, Pittsburg; Elliott Reynolds; Electric Appliance Company, O. T. Kimmel, Columbus, Ohio; Perry R. Boole, Chicago; Erner Hopkins Company, W. A. Hopkins, Jr., Columbus; Fort Wayne Electric Works, T. J. Ryan, Cincinnati; George B. Edgar, Cincinnati; General Incandescent Arc Light Company, W. F. Geddes, 3rd, Cleveland, Ohio; H. B. Coles, Cincinnati; General Electric Company, W. M. Demming, manager, W. J. Hanley, H. C. Houck, S. D. Gilbert, Cincinnati; Matthew O. Troy, Schenectady, N. Y.; Kuhlman Electric Company, Elkhart, Ind.; W. G. Nagel Electric Company, W. G. Nagel, E. J. Paradis, J. M. Wood, Toledo, Ohio; Post-Glover Electric Company, Charles S. Kuntz, Cincinnati; Nernst Lamp Company, D. D. Strite, Pittsburg; National Electric Company, Charles G. Burton, Chicago; National Carbon Company, F. H. McDowell, Cleveland; Otis Elevator Company, A. H. Wright, Cleveland; J. A. Roebling's Sons Company, W. P. Bowman, I. W. Brooks, Cleveland, Ohio; W. W. Affleck, Cleveland, Ohio; Standard Electric Company, P. J. Williams, Cincinnati; Stanley Instrument Company, F. J. Alderson, Great Barrington, Mass.; Stanley Electric Manufacturing Company, O. H. P. Fant, Cincinnati; Sprague Electric Company, O. P. Fant, Cincinnati; Westinghouse Traction Brake Company, William D. Ray, Cleveland; Western Electric Company, Charles W. Cobb, Cleveland; Westinghouse Electric & Manufacturing Company, Nathaniel Paige, Jr., Leon Goldsmith, Columbus, Ohio; J. W. Schrantz, Cincinnati; K. C. Randall, E.E., Pittsburg.

Hoisting and Transferring Machinery.

Two types of machines are employed in the handling of heavy materials, viz.: 1. A hoist for vertical movement. 2. A crane or trolley for horizontal movement.

Where the load exceeds the lifting capacity of one or two men, the hoist is the absolutely essential factor, while the crane or trolley

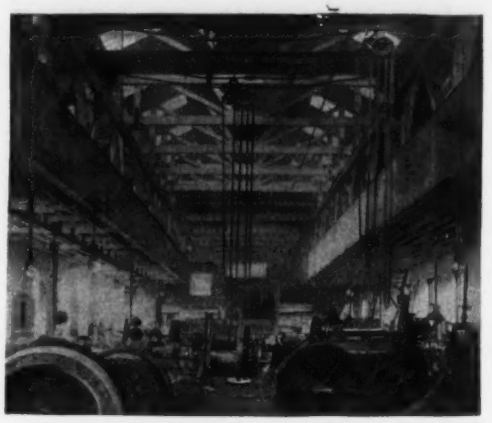


FIG. 1.—HOISTING AND TRANSFERRING MACHINERY.

may or may not be necessary. In other words, in every machine of this class the hoist is the vital part. In considering apparatus for transferring material, this fact is sometimes overlooked, and chief attention given to the mechanism for horizontal motion. While this is important, the mechanism for vertical motion—that is, the hoist—is still more important.

One of the simplest, most compact and most mechanical forms of hoist is the "triplex block," which has the further important advantage of possessing a high mechanical efficiency. In its standard form, it is a portable machine, intended to be hung by its hook to some overhead support, either fixed or movable; but it is also arranged to be built into a trolley intended to travel either on a crane or on an overhead tramway. It is thus available as the

FIG. 2.—HOISTING AND TRANSFERRING MACHINERY.

hoisting device in almost every type of machine for the handling of material.

Twenty tons may be lifted with it 5 ft. in ten minutes, and 300 pounds or less 30 ft. a minute. Where the load is less than a hundred pounds a quick speed block often saves a great deal of unnecessary strain in reaching the required position.

The accompanying illustrations show two of the many possibilities offered by the triplex block of the Yale & Towne Manufacturing Company, New York City, as a hoisting device in apparatus designed for the transfer of material.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was somewhat steadier towards the end of the week, due to the rally in prices from the depression caused early in the week by adverse talk about conditions at Montreal, Pittsburg and other cities, and the further breaks in various industrial stocks. Transactions were restricted and professional. Railroad stocks showed firmness in the main, while industrials rallied somewhat. A good effect was produced by the declaration of the usual ½ per cent. dividend on Amalgamated copper. The United States Steel securities developed further weakness, making new low price records. At the close of the week, however, there was a firmer tone in these issues. Rather heavy liquidation took place in Brooklyn Rapid Transit, but on the other hand Manhattan Elevated received support, notwithstanding the threatening attitude of its motormen and the possibility of a strike. Brooklyn Rapid Transit closed the week with a net gain of 1½ points, the closing quotation being 33¾. Metropolitan Street Railway was also favorably affected and closed at 105¼, being a net gain of 3¼ points. Manhattan Elevated closed at 132½, a gain of 2¼ points. General Electric closed at the highest point of the week—148—which was a net gain of 4 points, and Westinghouse common gained 4 points, closing at 138, while first preferred lost 11 points, the last quotation being 161. Western Union remained steady at 82. Following are the closing quotations of October 20:

NEW YORK.

	Oct. 13	Oct. 20		Oct. 13	Oct. 20
American Tel. & Cable	78¾	78	General Electric	140⅜	147
American Tel. & Tel	..	122	Hudson River Tel	..	..
American Dist. Tel	24	..	Metropolitan St. Ry	103	105¼
Brooklyn Rapid Transit	31⅞	33⅝	N. E. Elec. Veh. Trns	..	4¼
Commercial Cable	145	140	N. Y. & N. J. Tel	..	..
Electric Boat	18	17	Marconi Tel	..	..
Electric Boat pfd	42	40	Western Union Tel	81¾	81¾
Electric Lead Reduction	1¼	*1⅛	Westinghouse com	131	131½
Electric Vehicle	4	5	Westinghouse pfd	161½	160
Electric Vehicle pfd	5	8			

BOSTON.

	Oct. 13	Oct. 20		Oct. 13	Oct. 20
American Tel. & Tel	120¼	123½	Western Tel. & Tel. pfd	80	*77
Cumberland Telephone	..	*115¼	Mexican Telephone	1⅛	1
Edison Elec. Illum	230	230	New England Telephone	*123	122½
General Electric	142	146	Mass. Elec. Ry	18	18¾
Western Tel. & Tel	10	*10	Mass. Elec. Ry. pfd	77⅛	77

PHILADELPHIA.

	Oct. 13	Oct. 20		Oct. 13	Oct. 20
American Railways	41	*42	Phila. Traction	93½	93⅝
Elec. Storage Battery	48	*50	Phila. Electric	5⅜	5⅜
Elec. Storage Battery pfd.	48	*50	Phila. Rapid Trans	11¾	11¾
Elec. Co. of America	7¼	7¼			

CHICAGO.

	Oct. 13	Oct. 20		Oct. 13	Oct. 20
Central Union Tel	..	..	National Carbon pfd	*85½	88
Chicago Edison	143	..	Metropolitan Elev. com	17	18
Chicago City Ry	170	170	Union Traction	4	3½
Chicago Tel. Co	115	..	Union Traction pfd	30	25
National Carbon	19	17			

*Asked

TROLLEY DEALS IN MICHIGAN.—H. B. Hollins & Company, No. 15 Wall Street, have been approached in the matter of consolidating the trolley lines west of Detroit, including those of Kalamazoo. The properties it is proposed to consolidate are the Detroit, Ypsilanti, Ann Arbor & Jackson, Detroit to Jackson, with the Ann Arbor city line and a branch from Ypsilanti to Saline, making in all about 100 miles. The Boland lines, including Jackson city, twelve miles; and Jackson-Albion road, about forty miles; from Jackson to Chelsea, twenty miles, and twelve miles east of Chelsea toward Ann Arbor. The Albion, Marshall, Battle Creek and Kalamazoo lines belonging to the Railway Companies General, forty-seven miles; and the Detroit, Plymouth & Northville, running from Wayne to Plymouth and Northville, sixteen miles, owned by the Boland syndicate, making a total of about 247 miles of electric lines. There is now outstanding in the Detroit, Ypsilanti, Ann Arbor & Jackson $2,600,000 in stock, the majority of which is held by Messrs. Hawks and Angus; first mortgage 5 per cent. gold bonds due February, 1926, $1,610,000; Detroit, Ypsilanti & Ann Arbor Railway Company first mortgage due 1924, $330,000 and Ypsilanti & Saline electric railway first mortgage 6 per cent bonds due July, 1910, $60,000, making a total bonded indebtedness of $2,600,000. The authorized amount of the consolidated mortgage of the Detroit, Ypsilanti & Ann Arbor Railway Company is $1,000,000, of which $600,000 is reserved to retire the first mortgage of the company and $70,000 have not been issued. The Detroit, Ypsilanti, Ann Arbor & Jackson issued $1,670,000 first consolidated mortgage 5 per cent. gold bonds due February 1, 1922. The authorized issue was $2,600,000, of which $900,000 are reserved to retire prior liens. The Union Trust Company, of Detroit, is trustee of all the mortgages and the par value of the stock is $100 a share.

BELL TELEPHONE STANDING.—In answer to a query as to the merits of Telephone & Telegraph stock, the Boston News Bureau says in its "Answers to Inquiries" column: The American Telephone & Telegraph Company is to-day earning more upon its shares than ever before in its history. The last annual report showed net earnings of $7,835,272, or $1,250,868 above the 7½ per cent. dividends paid. This does not, however, represent the total share earnings of the company, as a large portion is left in the treasuries of the subsidiary companies, which pay dividends to the parent company. The dividends received from the sub-companies are almost equal to the dividend requirements of the parent company, and the latter has in addition its net earnings from the long distance lines, which it operates directly, and rentals of instruments, which are paid by the license companies in addition to dividends. The parent company is obliged to raise about $20,000,000 new money every year to provide for new construction. It does this by issuing new stock to stockholders at par. In former years the new issue created valuable rights, but this year, owing to the condition of the money market and to the temper of the public toward new issues of securities, the new issue was not so favorably received. At the present market price American Telephone yields 6¼ per cent. without allowance for "rights" to take new stock at par.

DIVIDENDS.—The Lowell, Mass., Electric Light Corporation has declared a semi-annual dividend of $4 per share, payable Nov. 2. Amalgamated Copper Company has declared a dividend of ½ of 1 per cent., payable Nov. 30. The U. S. Steel Corporation has declared a dividend of ½ of 1 per cent. on the common and the full 1¾ on the preferred. The directors of the American Light & Traction Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable Nov. 2. The directors of the Henry R. Worthington Company have declared the regular semi-annual dividend of 3½ per cent. on the preferred stock, payable Nov. 2. The directors of the International Steam Pump Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable Nov. 2. The Milwaukee Electric Railway & Light Company has declared the regular quarterly dividend of 1½ per cent. on its preferred stock, payable on Nov. 1. The Columbus Railway Company, of Columbus, Ohio, has declared a dividend of 1¼ per cent. on the preferred stock, payable Nov. 2.

SAO PAULO, BRAZIL, TROLLEYS.—Mr. F. S. Pearson, consulting engineer of the Sao Paulo Light, Heat & Tramway Company says: "With the additions to the various departments in operation, the company should this year earn 11 or 12 per cent. While it is proposed to increase the dividend, I do not think such a course will be adopted. I would rather favor the establishment of a reserve fund. The million dollars advanced a little over a year ago for construction work has resulted in the company being able to extend its mileage considerably and it has now been all completed. Fifteen of the 30 new cars are already in use and the remainder will be in use before the end of the month. In the month of September the earnings were $16,000 more than in the corresponding month last year and now the company will be in a position to make a more marked increase."

ELECTRIC LIGHT EARNINGS.—The Minneapolis General Electric Company showed a gross for August of $39,144, a little more than $3,000 better than last year. The gross for 12 months was $539,882 and net $131,154. The Edison Brockton Company for August showed gross of $7,256 against $6,320 last year, and $524 net. The gross for 12 months was $103,329 against $92,191, but the net was $18,220 against $26,209.

PHILADELPHIA ELECTRIC.—A director of the Philadelphia Electric Company says: "The Philadelphia Electric Company, at its present rate of earnings, will show for the present fiscal year about $600,000 net profits for the stock, equivalent to 8 per cent. Although we are able, therefore, to pay more than the standing rate of 5 per cent., there is no probability of an advance. At this time such a step would be unwise."

OTIS ELEVATOR COMMON STOCK.—The directors of the Otis Elevator Company have decided not to pay an October dividend on the common stock. The earnings of the company for the past six months warranted the distribution of a semi-annual dividend of 2 per cent., but so much work has been stopped by the building strikes it was considered more prudent to suspend the dividend for the present.

COMPETITION AT QUINCY, ILL.—In view of proposed competition in the electric lighting field, the Quincy (Ill.) Gas & Electric Company, through Mr. J. C. Sloan, manager, has issued a circular to the citizens in which it says: "The present stockholders and officers of the Quincy Gas & Electric Company took possession of the property of this company, and the management thereof, during the month of April, 1903. The new officials were, at the time, unacquainted with the business affairs of the company, but after entering upon their duties and acquainting themselves therewith were led to believe, and acted thereon, that a reduction in the price to consumers of electric current, in many instances, was demanded and that a uniformity, as to the price charged to customers, graded according to consumption, should be made. They thereupon at once reduced the price from 15 cents per 1,000 watts to 12 cents, which has been the price since then charged; also at once establishing a uniformity in price between customers graded according to the amount consumed. They believe that the rates, as now established, are fair to the consumer as well as to the stockholders of the company, and assure the patrons of the company that there is no extortion practiced, and that such rates realize but a low per cent. upon the actual value of the assets of the company. In anticipation of competition, the Independent Light & Power Company, which is now erecting a plant in the city, has taken contracts for the furnishing of current at a rate lower than that charged by this company, and, as the officers of this company are informed, are still importuning other users of electric current to enter into contract with it. This company fully understands what competition means and will assure its patrons that when such competition is to be met it will furnish electric current to the consumers thereof in the city of Quincy at a price less than our competitor, regardless of the loss it will cause this company. While this company would prefer to manufacture electric current at a reasonable manufacturer's profit, as it is now doing, it has decided to meet any and all competition at whatever cost. It will be to the advantage of our patrons, and to the consumers of electric current in Quincy, to await the time when competition shall have commenced before entering into any contract for the furnishing of current with either the old or the new company; for, as stated above, no matter what price the new company may furnish current for, this company will sell the same at a less price."

TRACTIONS IN NEW YORK.—Gossip, as follows, is given by the *Wall Street Journal.* Evidence is accumulating that the continued bear manipulation of local traction stocks by E. C. Potter & Company and other firms, is really in the interest of Interborough people. It is current rumor that the Belmont people have allied themselves with the Rockefeller-Gould interests in the management of Interborough and that this combination is bent upon consolidating all the traction and electric light and power interests of Greater New York. So far it is claimed that these interests have forced out very large sales of Metropolitan stocks as well as Brooklyn Rapid Transit, by driving down the prices of these securities. Some of the leading and largest holders of these stocks are not opposing the decline, but are not selling their own holdings because they believe that the movement of the Interborough people will be for the best interests of all concerned.

BOSTON EDISON REPORT.—The stockholders of the Boston Edison Electric Illuminating Company at their annual meeting on October 13 re-elected the directors. The report for the year ended June 30, 1903, shows a gross income of $2,667,808 and a total net income of $1,017,225. Some further figures were given in these pages last week. President Edgar said: "The company has purchased the past year seven acres of land adjoining the L street property in South Boston, and plans for a 75,000-hp station have been prepared. Contracts have already been let for the first section of the new station building, and upon the completion of this section of the plant, all of the towns reached by the suburban companies recently purchased will be supplied from your Boston station, and Boston prices for electricity will be adopted in these districts."

EARNINGS OF NATIONAL CARBON.—Representatives in Chicago of the National Carbon Company claim that the first eight months of 1903 show that the earnings of the concern will be fully equal to those of 1902, the net earnings of which were $594,371, out of which $315,000 for dividends and $254,396 for depreciation were deducted, leaving the small surplus of $22,734. The total surplus shown in the last statement was $156,000. If the directors follow their former policy of charging off a large sum to depreciation, the next statement of the year ending Jan. 31, 1904, will show that $1,000,000 has been charged to this account during the five years that the concern has been in business.

CINCINNATI BELL TELEPHONE STOCK INCREASE.—The directors of the Cincinnati Bell Telephone Company have decided on an increase of the company's capital stock, amounting to 4,581 shares with a par value of $242,500. The proceeds of the issue will be used in erecting and equipping the new exchange at Canal and Race Streets.

BOSTON EDISON INCREASE.—The Mass. Board of Gas and Electric Light Commissioners has granted the Boston Edison Company permission to issue 20,000 shares of new capital stock at $200 a share, to provide money for improvements and betterments.

Commercial Intelligence.

THE WEEK IN TRADE.—The urgent demand which has been conspicuous in general trade and industry at this season in late years is not in evidence this year. There are exceptions, however; in the southwest the demand as a whole is reported equal to that of last year and at some points in the northwest and on the Pacific coast. In the central west business is fair, but at the east the quietness is increasing, and reports from the south are rather less favorable. The shut-downs of iron furnaces fail to stimulate values in this line. Iron is weak and lower at all markets, and a heavy curtailment in output is expected this month. Finished products are very firm considering the heavy drop in raw materials. Good sales of rails are noted; and wire, nails and bars are active at the west. Money is easier at large centers; collections are still complained of as slow and colder weather is apparently needed to stimulate retail demand for various products. There are some favorable features in the situation, however. The cereal crop yield as a whole, though 10 per cent smaller than that of last year, is of better grade, and compared with 1901 a gain of 25 per cent. in the bulk yield is figured. Railway earnings indicate that a large volume of business is still being transacted. Reports of suspension of improvement work by railroads come earlier this year than usual, but sales of new rails, cars and supplies indicate that much of this is largely seasonal. The copper market continues dull and buyers are holding off, while producers are not pressing the market. A fair business was done for export at slightly lower prices. The closing quotations are 12⅝ to 12¾c. for Lake; 12½ to 12⅝c. for electrolytic; 12¼ to 12⅜c. for cathodes and casting stock. The business failures for the week ending October 15, as reported by *Bradstreet's,* numbered 203, against 197 the week previous, and 203 the corresponding week last year.

EQUIPMENT FOR COLD STORAGE PLANT.—Conron Bros., provision dealers, New York City, have let a contract to the Mackay Engineering Company, 149 Broadway, for various equipment. A 125-hp vertical compound engine has been ordered for direct-connection to a 75-kw generator; also a 150-hp engine for direct-connection to a 100-kw generator, also several motors of various capacity. The equipment will be used for lighting and power in a new cold storage plant being constructed by the Conron people. The engines will be built by the Reeves Engine Company, of Trenton, N. J. The Akron (Ohio) Electric Manufacturing Company will supply the generators and motors.

MEXICAN HYDRAULIC PLANT.—A large hydraulic power plant is to be constructed on the extensive Tanchachin estate in the Tampico division of the Mexican Central Railway, between Rascon and Micos. The property has just been sold by Mariano Barragan to D. J. Spillane, Daniel Spillane and George C. Hippertz, who are about to let contracts for the equipment of the plant. Power will be derived from a waterfall 272 ft. high, over which the waters of the Callinas, Tamasopo Sta, Maria, Rio Verde and Tamul Rivers flow.

STATEN ISLAND PLANT.—Milliken Brothers, Bowling Green Building, which concern is building an extensive plant at Staten Island for the manufacture of structural steel, will shortly let contracts for electrical equipment. The capacity will be 1000-kw. Several electric traveling cranes will be installed. The Shaw Electric Crane Company will build a number. The consulting engineer for the construction of the plant is G. K. Hooper, Bowling Green Building.

ELECTRIC HOISTING EQUIPMENT FOR WELSH STEEL PLANT.—Mr. W. A. Stadelman, of the Brown Hoisting Machinery Company, of Cleveland, Ohio, New York offices Havemeyer Building, has secured a contract for electric hoisting equipment for installation in the Ebbw Vale Iron & Steel Company's plant in South Wales. A contract for electric trolleys has also been secured through the export house of Henry W. Peabody & Co., 17 State Street, New York, for South Africa.

MOTORS OF BATTLESHIP IOWA.—The United States battleship *Iowa,* now under construction in the Brooklyn Navy Yard, is to be equipped with some 20 Holtzer-Cabot motors for driving ventilators. The Holtzer-Cabot Electric Company has also secured a contract for 30 motors of 1-5 capacity, and of special design for jewelers' polishing and grinding purposes. This contract came through W. Green & Co., 6 Maiden Lane.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has carried out during the past half year the design and construction of over 50,000 kw of large alternating and direct-current machinery Among the more prominent contracts have been: Ten 1,000-kw generators and motors for the Shawinigan Water & Power Company in Montreal; five 3,000-kw alternators for the Kern River Power Company, of Los Angeles, Cal.; three 1,500-kw alternators for the Pacific Electric Railway Company, of Los Angeles, Cal.; two 1,500-kw fly-wheel type alternators for the Mutual Electric Company, of San Francisco, Cal.; one 1,500-kw alternator for the Pacific Light & Power Company, of Los Angeles, Cal.; one 800-kw fly-wheel type alternator for the Los Angeles Traction Company, of Los Angeles, Cal.; two 11,000-volt, 200-kw motor generator sets for the San Bernardino Valley Traction Company, San Bernardino, Cal.; one 1,500-kw fly-wheel type alternator for the Denver Gas & Electric Company, of Denver, Colo.; two 1,000-kw generators and five 400-kw rotary converters for the Scioto Valley Traction Company, Ohio; two 750-kw alternators for the New York Central & Hudson River Railroad; one 3,000-kw fly-wheel type alternator for the Cincinnati Gas & Electric Company, Cincinnati, Ohio; one 3,000-kw, direct-current generator for the Cincinnati Gas & Electric Company, of Cincinnati, Ohio; two 1,000-kw generators for the Niagara Falls Hydraulic Power & Manufacturing Company, Niagara Falls, N. Y.; two 200-kw, 12,000-volt generators for the Island Pond Electric Company, Island Pond, Vt.; one 1,000-kw generator for the Canadian Electric Light Company, Quebec.

EXPRESSAGE IN BROOKLYN, N. Y.—It has been understood for some time that Brooklyn Rapid Transit contemplated engaging in the business of hauling ashes, building material and other low grade freight over its lines at night when this could be done without disturbance to its passenger business. There are now on the Thirty-ninth Street pier at South Brooklyn, standing on flat cars of the Seaboard Air Line a number of new covered freight cars bearing the name of Brooklyn Rapid Transit, and which are designed for the transportation of packages of high class freight. The cars are in all respects similar to those of the National Express Company now operating on Brooklyn Rapid Transit lines except that the latter are blue, while the new ones are red and bear the name of the Transit and not of the Express Company. Inquiry develops the fact that the Brooklyn Rapid Transit Company has plans for the inauguration of a system of merchandise delivery from block to block with the establishment of convenient stations for the handling of packages. Such business will be largely carried on at night, but much can also be done in the day time on lines where this would not produce congestion. The system would thus be analogous to that of the Metropolitan Express Company in New York City.

VILTER COMPANY PLANTS.—The Vilter Manufacturing Company, builders of refrigerating and ice-making machinery, Corliss engines, etc., Milwaukee, Wis., has recently closed contracts with the following parties: Bay City Ice, Light & Power Company, Bay City, Tex., 15-ton ice plant, with 3-ton refrigerating machine; Dalhart Ice & Electric Company, Dalhart, Tex., 30-ton ice plant; Milwaukee Malting Company, Milwaukee, Wis., 24 x 42 Corliss engine; Hastings Wool Boot Company, Hastings, Mich., 18 x 28 x 42 cross-compound Corliss engine; Milwaukee-Western Malt Company, Milwaukee, Wis., 20 x 42 and 16 x 36 Corliss engine; Imperial Furniture Company, Grand Rapids, Mich., 18 x 42 Corliss engine; Menasha Wooden Ware Company, Menasha, Wis., 20 x 40 x 48 cross-compound Corliss engine; Independent Malting Company, Davenport, Iowa, 16 x 36 Corliss engine; Ward-Corby Company, Providence, R. I., 10 x 24 Corliss engine; North Branch Lumber Company, Chicago, Ill., 24 x 48 Corliss engine; Adam Schillo Lumber Company, Chicago, Ill., 22 x 42 Corliss engine; City of Algoma, Wis., 17 x 36 Corliss engine; C. A. Lawton Co., De Pere, Wis., 12 x 30 Corliss engine; C. F. Baum Company, Chicago, Ill., 12 x 36 Corliss engine.

ALLEN & DYER is the name of a new firm at Calle San Juan de Letran 5½, Mexico. Mr. Carlos E. Allen was at one time engaged in the mining districts of El Oro, Guanajuato, Jalisco and other Mexican States, and the last six years was with the State Government of Michoacan, Mexico, and for eleven years has had experience in operating and installing steam, electrical and mining machinery. Mr. Seth H. Dyer was at one time in the General Electric shops in the United States, and later with the Guanajuato Consolidated Light & Power Company and other companies in Mexico. The firm will undertake mechanical and electrical engineering and the erection of all kinds of machinery in Mexico, Central America and South America. They will also act as resident engineers for companies desiring such representation.

THE WESTINGHOUSE STEAM TURBINE is rapidly increasing its field of usefulness. The Eaton Cole & Burnham Company, of Bridgeport, Conn., is preparing plans for a turbine plant which will furnish power to its works at Bridgeport, Conn. Large extensions are now under way, and the entire plant will be operated by polyphase motors from the new power station. A 400-kw Westinghouse turbine unit will be immediately installed to provide additional power during the construction work. It will temporarily be placed in the present power house and will operate under 200 pounds steam pressure and 28 inch vacuum without superheat. The unit will furnish three-phase current at 440 volts. The installation is in charge of Mr. Geo. Hooper, engineer, No. 11 Broadway, New York.

EQUIPMENT FOR MONEY ORDER PLANT.—The Mackay Engineering Company, 149 Broadway, has secured a contract from Paul Herman for the equipment of the machinery which is to print the government money orders. Three Hoe cylinder presses, two Scott lithographic presses, together with two perforators and a paper cutter, will be electrically driven. The motors to operate the Hoe presses will be of 7½-hp capacity each. A 10-hp motor will drive the lithographic presses. The perforators will be worked by ½-hp motors and the cutter will be driven by a 3-hp motor. All the motors will be of Akron build. They will be of special slow-speed type, with latest improved Carpenter controllers, with variable-speed and safety devices and magnetic brakes.

THE HOLOPHANE SYSTEM IN CHICAGO.—The Windemere Hotel in Chicago has redesigned its system of lighting and installed the holophane system, saving thereby on an average 35 per cent. of its current consumption. The dining-room is entirely lighted by ceiling lights, which are practically out of the range of vision of people seated at the tables. The lighting of the billiard room is a special feature, absolutely no shadow of the balls or the cushions being cast on the table. At the same time the lights are hidden from view. The halls are all lighted by ten-inch holophane hemispheres, giving a soft and subdued yet powerful light. The work was designed and installed by the V. R. Lansingh Company, of Chicago.

ST. LOUIS EXPOSITION.—The steam power plant of the St. Louis Exposition, now being built by Messrs. Westinghouse, Church, Kerr & Company, will be fitted with two large central condensing units, each consisting of a 40-in. elevated condenser capable of handling 96,000 lbs. of steam per hour. These condensers are being built by Henry R. Worthington, of New York City, who will supply centrifugal pumps for handling the circulating water. That Company will also furnish the rotative dry vacuum pumps which will remove all air from the condenser system. The boiler feed-pumps of this immense power plant are likewise of Worthington make.

THE NORTHWESTERN ELECTRIC COMPANY, of Chicago, has been incorporated. S. H. Martin is president, M. J. Clark, vice-president, and J. R. Dean, secretary and treasurer. The members of the company are well known to the trade, having been connected with a well-known concern for a number of years. The company will make a specialty of buying and selling second-hand electrical machinery, and of expert electrical repairing. A factory at 71 West Washington Avenue has been equipped for that purpose. It is also the manufacturer of the well-known S. H. M. brush holders and of a line of ground detectors.

THE EUREKA ELECTRIC COMPANY, of Chicago and Genoa, Ill., has just closed contracts for immediate shipment of a very large outfit of its improved telephone apparatus for installation at Cebu, Philippine Islands. The company is this month making four shipments to foreign countries. The government of Salvador has just placed another contract for a large shipment with this company, after having used its apparatus for the last five years, proving its superiority when placed in comparison with foreign makes.

PITTSBURG STEEL COMPANY IN CANADA.—A deal has just been closed by which the Pittsburg Steel Company takes a lease of a portion of the Hoepfner refinery buildings in Hamilton, Ont., for one year. This means that the Pittsburg Steel Company will at once begin operations in Hamilton. A contract has been closed with the Cataract Power Company, of Hamilton, for electric power. It is expected that before the expiration of the lease, the company will have its own site and buildings.

ILLINOIS CENTRAL SIGNALS.—Arrangements have been made for the installation of the telegraphic block signal system on the entire system of the Illinois Central. It is estimated that the cost of the improvement will reach $1,000,000. According to the present intentions of the executive officials of the company the entire main line, about 3,000 miles, will be blocked as fast as possible, and it is expected three years will be consumed in completing the work.

BALL ENGINE ORDERS.—The Sheridan Iron Works, of Champlain, N. Y., have recently ordered a 70-hp direct-connected engine from the Ball Engine Company, Erie, Pa. The City Electric Light plant at Schuyler, Neb., will install a 175-hp engine, furnished by the Ball Engine Company. The Ball Engine Company has sold the Dundee Textile Company, Passaic, N. J., a 175-hp direct-connected unit.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—The Sunset Telephone & Telegraph Company has purchased a building here and fitted it up with the modern equipment. On October 1 the central energy system was inaugurated. Throughout the business portion of the city all cables have been laid underground.

LOS ANGELES, CAL.—The Home Telephone Company has begun service on its long-distance lines between this city and Long Beach, where it has 300 telephones installed.

SANDERSVILLE, GA.—A new telephone company is being organized at Sandersville with a capital stock of $12,000 to compete with the Southern Bell Company.

CARROLLTON, GA.—The Gainesboro Telephone Company, of this city, has secured the privilege to increase its capital stock from $40,000 to $150,000. It has built five large exchanges and strung some 300 miles of wire in this and the six adjoining counties and has 500 stations.

CHICAGO, ILL.—The Chicago Telephone Company made a total gain in September of 1603 telephones. The total now in use is 95,628.

EAST ST. LOUIS, ILL.—Arrangements are being made by the Kinloch Telephone Company to install a complete system of underground conduits for its wires in East St. Louis.

MONMOUTH, ILL.—The Central Union Telephone Company contemplates building an entirely new plant in this city to replace the one now in operation. The improvements will be made at an expense of about $25,000.

DECATUR, ILL.—A syndicate, including Col. James S. Culver, of Springfield, John H. Culver, of Decatur, E. W. Hight, of Assumption, has purchased the Douglas County Telephone Company, a concern operating in Eastern Illinois, with 500 miles of wire and 800 farmers' telephones. It is the intention to make extensions.

CHICAGO, ILL.—According to the new directory of the Illinois Telephone & Telegraph Company the company now has 625 subscribers in the down-town district. The contracting department is a way ahead of the constructing department, orders being received at the rate of 90 per day, while instruments are being installed at the rate of 75 per day.

CHICAGO, ILL.—The new Douglas Exchange of the Chicago Telephone Company was opened recently and the service of about 4,400 subscribers has been transferred to it from other exchanges. This exchange district embraces the territory between 29th Street on the north, the Union stock yards and Transit railroad track on the south, and the Rock Island railway track on the east. It is located at 35th Street and Grand Boulevard.

CHICAGO, ILL.—According to an opinion rendered by the corporation counsel, the Chicago Telephone Company owes the city more than $500,000 in back compensation. The city for years has claimed that the telephone company owed 3 per cent. compensation on its gross receipts in the towns of Hyde Park, Lake, Lake View and Cicero where, under the old ordinances of the towns, the latter paid no compensation. Steps are now to be taken to collect the amount.

DECATUR, IND.—At the annual election of the Citizens Telephone Company the following board of directors was elected: John Baker, Henry Hite, E. H. Ehniger, F. M. Schirmeyer and J. W. Tyndall.

ELWOOD, IND.—There are signs of a telephone war here between the Bell Company and the Delaware and Madison Company, the latter an independent concern. The independent company is trying to get exclusive control of the field, and it is endeavoring to induce business houses and citizens to discontinue the use of the Bell telephones.

ANDERSON, IND.—The Farmers Telephone Company has just completed a neighborhood line in this county. The line extends east and north of Alexandria and has 53 subscribers. It will connect with the Delaware and Madison County line at Alexandria. Marshall Walker organized the company and built the line.

CHESTERFIELD, IND.—The Chesterfield Telephone plant was burned out on Oct. 8 by the cable coming in contact with the trolley wire of the Union Traction Company. The entire system was destroyed and the three-story brick building in which the exchange was located was badly damaged by the resulting fire.

CEDAR FALLS, IA.—The Iowa Telephone Company, it is stated, will rebuild its exchange here.

SIOUX CITY, IA.—The Sioux City Telephone Company has been incorporated with a capital stock of $10,000. Mr. H. Woodruff is the only incorporator of this company.

GETTYSBURG, MD.—The United Telephone & Telegraph Company is rebuilding its lines in Adams County.

HUNTER, MD.—The Hunter Telephone Company has been organized with a capital stock of $5,000. It will build lines in different directions throughout this section.

BALTIMORE, MD.—The Maryland Telephone & Telegraph Company has concluded a traffic agreement with the United Telephone & Telegraph Company of Pennsylvania. Under this agreement the Maryland Company gets a connection with Hagerstown, Md., Winchester, Va., Chambersburg, Carlisle and Harrisburg, Pa., and many other places throughout a large territory.

TRAVERSE, MICH.—The Traverse Bay Telephone Company, of Central Lake, has been incorporated with a capital stock of $4,000.

HART, MICH.—The Oceana Telephone Company has built over 50 miles of new line this season and will soon have 700 telephones in operation. It pays a dividend of 6 per cent.

CHILLICOTHE, MO.—The Livingston County Telephone Company has filed articles of incorporation, the capital stock being $2,000. The shareholders are S. J. Miller, A. M. Shelton, F. S. Miller, Maude Miller and D. F. Williams.

LIVINGSTON, MONT.—The Yellowstone Park Telephone & Telegraph Company has been incorporated with a capital stock of $10,000 by Frank A. Hall, Geo. W. Boyce and George Cox.

JERSEY CITY, N. J.—Eastern Illinois Independent Telephone Company of Jersey City, N. J., has been incorporated, capital stock $500,000; capital in Illinois, $50,000.

MORRIS, N. Y.—The Butternut Valley Telephone Company, of this place, has increased its capital stock from $3,500 to $6,000.

OSWEGO, N. Y.—The Empire State Telegraph & Telephone Company is seeking a franchise in this city. It is stated that the company will spend $100,000 on a new exchange.

CHARLOTTE, N. C.—It is reported that a new telephone company, the third one in the city, will be organized here to install a local system.

REIDSVILLE, N. C.—The Southern Bell Telephone Company has absorbed the local independent exchange at Reidsville and will shortly put in a modern common battery system. A number of toll lines were included in the deal.

COLUMBUS GROVE, OHIO.—The village council has granted a franchise to the Bell Telephone Company.

SPRINGFIELD, OHIO.—Linemen employed by the Central Union Telephone Company here are on strike.

PLAINFIELD, OHIO.—The Plainfield Telephone Company has changed its name to Consolidated Telephone Company.

SPENCER, OHIO.—The Spencer Telephone Company, capital $5,000, has been incorporated by N. E. Fuller, F. T. Cavin, M. M. Freeman and C. S. Rice.

LORAIN, OHIO.—The Black River Telephone Company operates a 2,000-drop Sterling switchboard and furnishes service to 1,400 subscribers. It is adding new subscribers at the rate of two per day.

CINCINNATI, OHIO.—The telephone company has filed an application for a permit to erect a new exchange building at the corner of Race and Canal Streets. It will cost $45,000.

LOGAN, OHIO.—The Logan Home Telephone Company bought out the Standard Telephone Construction Company last March, changed the name and rebuilt the system. It expects to install 600 telephones. There are 350 subscribers to the exchange and 24 miles of toll line. The company expects to continue building farmers' lines.

CALEDONIA, OHIO.—The Caledonia Telephone Company has been incorporated with $25,000 capital stock by J. Pommert, C. E. Kelly, L. C. Donnenwirth, T. J. Pittman, Fred Busch and J. Rinker. The company has purchased the system in Marion County operated by Mr. Pommert. The company proposes to extend the system through Marion, Morrow and Crawford counties.

HAMILTON, OHIO.—A syndicate of Hamilton capitalists, headed by O. M. Bake and Louis P. Clawson, has bought from the Northwestern Construction Company, of Bryan, Ohio, the Hamilton Home Telephone Company, which is allied with the United States Telephone Company. Connections are now being completed with Dayton and an entrance to Cincinnati will probably soon be made.

MARION, OHIO.—The Marion County Telephone Company controls five rural exchanges, three of which have been in operation since July, the other two just being equipped. The Marion exchange has 1,237 subscribers. The company's officers are Mr. F. E. Guthery, president; Mr. S. E. Barlow, vice-president; Mr. Oswald Wollenweber, treasurer; Mr. French Crow, secretary, and Mr. D. M. Odaffer, general manager.

POND CREEK, O. T.—The Rural Telephone Company of Pond Creek has been incorporated with $5000 capital. The incorporators are Henry F. Wilkin, John H. Dunkin and S. D. Million.

LAMONT, O. T.—The Lamont and Eddy Rural Telephone Company, of Lamont, has been incorporated with a capital stock of $312. The incorporators are John B. Cowen, Art. Hollopeter and Swan Olson.

BLACKWELL, O. T.—The Blackwell Rural Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are W. Harshman, William Risley, C. E. Fondrey and A. Durand.

ROCK HILL, S. C.—The Southern Bell Telephone Company is seeking franchises and installing systems in a number of smaller towns in South Carolina where independent systems are already in operation. Among the towns included are Rock Hill, Yorkville, Lancaster and Camden.

DEADWOOD, S. D.—The Nebraska Telephone Company will expend $30,000 on its local exchange in this city.

SPARTA, TENN.—The property of the defunct Overton Telephone Company has been purchased by the Gainsboro Telephone Company. The Gainsboro Company is extending its mileage in Tennessee and Kentucky and adding many new exchanges.

NASHVILLE, TENN.—The Tennessee Telephone Company has petitioned the City Council for permission to establish an independent telephone system in Nashville. A 50-year franchise is desired and the right is given the city to purchase the plant after 25 years. It is proposed to furnish telephones at $3 per month for business houses and $2.50 for residence instruments. Thirty free telephones will be given the city and a reduced rate made on additional ones which may be needed.

GAINESVILLE, TEX.—The People's Home Telephone Company, of this place, will build a copper wire telephone line to Cleburne.

CLEBURNE, TEX.—The new telephone exchange of the Automatic Telephone Company at this place will be opened in a few weeks. F. B. McElroy, of Fort Worth, is vice-president of the company.

SOUR LAKE, TEX.—The Sour Lake Telegraph & Telephone Company is installing a telephone exchange at this place. It placed 100 telephones in operation on October 2 and this number will be increased when the plant is completed.

TEXARKANA, TEX.—The New Long-Distance Telephone Company has been organized here with a capital stock of $200,000 for the purpose of establishing an extensive system of telephone lines in northeastern Texas. The incorporators of the company are John P. King and Joseph Huckins, Jr., of Texarkana, Tex.; John B. King and W. L. Estes, of Texarkana, Ark.; W. P. Harrison, F. M. Marrott and F. E. Harrison, of Ohio.

BEAUMONT, TEX.—The Beaumont & Northwestern Telephone Company is extending its system to Silsbee, Kountze and Saratoga. Preparations are being made by the company to build a copper metallic circuit between Beaumont and Sour Lake. The Beaumont & Northwestern Telephone Company is making arrangements to extend its line from Cleveland, Tex., to Japan, Tex., and thence to Houston by way of Humble. J. M. Smith is general manager. The same interests own the Beaumont and Northwestern and the Beaumont and Southwestern telephone systems.

ELECTRIC LIGHT AND POWER.

ALAMEDA, CAL.—The City Trustees are considering the purchase of two 75-light transformers at a probable cost of $4500.

LOS ANGELES, CAL.—The Pacific Light & Power Company, through M. C. Osborn, has petitioned the Town Trustees of Alhambra to advertise for sale a franchise for the operation of an electric light and power system in Alhambra, to cover a period of 50 years. Bids will be opened on November 24.

LOS ANGELES, CAL.—It is stated that H. E. Huntington is going into the San Bernardino Mountains after power and incidentally take from the Edison Electric Company, his rival, certain power rights which he alleges it has slept upon. Mr. Huntington is at the head of the Pacific Light & Power Company. The controversy centers on the right to use the water in Bear Creek between Corkscrew Falls and the junction of the Santa Ana River. John C. North, of Riverside, and a corps of surveyors are now in the mountains for the Huntington interests running lines and making preparations for the immediate erection of a power house.

EAST ST. LOUIS, ILL.—The Citizens' Light & Power Company has increased the number of its directors from three to five.

SHELBYVILLE, ILL.—The City Council has decided that the city shall operate the electric light plant, recently turned over by H. B. Trout, who has leased it for three years. As the law does not grant power to the city to conduct a plant for commercial lighting purposes, it is announced that the city will be enjoined from running this plant under a contract with Trout. The city paid $10 a year for each street light, but the actual cost of operating each was over $50. Until the plant is enlarged, which will cost $8000, the city will be in darkness.

EVANSTON, ILL.—The Yaryan Company, which has been heating most of the public buildings and many of the private residences of Evanston, will, it is rumored, abandon its franchise. Recent differences that have arisen between the company and its patrons are said to be the cause. The city council has refused to take any definite action. Many who have been patrons refused to install asbestos-covered pipes and storm doors and windows required by the company, which refuses to supply heat unless these conditions are fulfilled.

MARION, IND.—The City Council has granted a franchise to the Citizens' Light & Heating Company.

MUNCIE, IND.—The Delaware County Commissioners are discussing the building of an electric light and steam-heating plant for the county institutions.

BLOOMINGTON, IND.—Engineers G. W. Scott and O. A. Thelin, of Chicago, Ill., are at the university making preliminary surveys and estimates for erecting a $20,000 addition to the power house, for increasing the electric supply. The entire heating arrangements of the university will also be remodeled.

BEDFORD, IND.—The Secretary of State has granted charters to the Cope's Shoals Hydraulic Company and the Clark's Ferry Hydraulic Company with Wm. L. Stoy, of Odon, Ind.; D. A. Yoder, of Vincennes, and Harry T. Crook, of Washington, directors of both companies. They propose to construct and operate a water power plant at or near Cope's Shoals, on the east fork of White River to operate a street and interurban railway through Vincennes, Washington, Loogootee, Shoals, Indian Springs, West Baden and through Knox, Daviess, Martin and Orange counties.

MASON CITY, IA.—Jas. Rule and others have petitioned for a franchise for an electric light, gas and heating plant.

OTTAWA, KAN.—John Nelson is reported interested in the construction of a power plant to develop and distribute electrical power.

FRANKFORT, KY.—The council has voted to enter into a contract with the People's Electric Light & Power Company to furnish the city 72 arc lamps at $80 per year. The present lights cost $96 per year.

FAIRFIELD, ME.—A. F. Gerald, of Fairfield, has purchased the water power at Fairfield Rip on Sebasticook River and will establish electric generators, and run a line of wire to Kennebec River.

WEST BAY CITY, MICH.—The commercial lighting furnished by the municipal lighting plant has proven so popular that the village finds it necessary to increase the facilities of its plant and new equipment will be purchased in the near future.

FOSSTON, MINN.—Bids are wanted Oct. 28 for $4000 light and water bonds. W. E. Black is recorder.

COLUMBIA, MO.—The voters of this city have decided in favor of municipal ownership of the electric and water plant. Another election will be called to issue bonds for the construction of the plant.

JOPLIN, MO.—A movement is on foot by Eastern and local capitalists to establish a large electrical plant for the purpose of operating all the mines and mills of the Missouri-Kansas mining district. It is said the central plant will be located in Joplin, while smaller stations will be located in Galena and Webb City.

ATLANTIC CITY, N. J.—The Herbath Mitchell Company, of New York City, N. Y., is about to ask City Council for a franchise to lay conduits and run wires in this city to furnish electric lights to private consumers. The company desires to lay conduits under the boardwalk and later string wires throughout the city.

FORT STANTON, NEW MEX.—The United States government is installing an electric light plant at this military post. M. H. Fisher, manager of the Alamagordo Electric Light Company, of Alamagordo, New Mex., has the contract for the work.

TRUMANSBURG, N. Y.—F. C. Biggs and O. G. Noble are interested in the construction of an electric light plant.

MOHAWK, N. Y.—The citizens are considering the construction of water works and an electric light plant, at a cost of $30,000.

BATH, N. Y.—Bids will be received Nov. 12 by Geo. W. Dunn, President of the Board of Trustees, at the N. Y. State Soldiers' and Sailors' Home, for reconstructing and repairing the electric plant; also installing engines, generators, switchboard, branch steam and exhaust piping at the N. Y. State Soldiers' and Sailors' Home. Address G. L. Heins, State Architect, Capitol, Albany.

WILSON, N. C.—A proposition is being considered by this town to lease its electric light plant to the Flagler interests.

VALLEY CITY, N. D.—All bids opened on Oct. 5 for constructing the municipal electric light plant have been rejected.

ATHENS, OHIO.—The council has sold $15,300 worth of municipal light bonds to E. M. Strandsberry & Company, of McConnellsville. The new plant will be erected as soon as possible.

TROY, OHIO.—Bids will be received Oct. 31 by the Board of County Commissioners for furnishing material and installing an electric lighting plant in the court house. Address E. E. Pearson, the County Auditor.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company was the lowest bidder for the contract for lighting the city and the contract will be entered into as soon as the council can grant the company a franchise.

GUTHRIE, OKLA. TER.—The electric light plant at this place has been sold. New machinery will be installed by the new company.

PATTON, PA.—The Patton Township Electric Light Company has been incorporated with a capital of $5000.

ALLENTOWN, PA.—U. H. Wienland, of Allentown, has secured the contract for the electric light plant at the pumping station. The contract calls for engine, dynamos, switches, etc.

CHERAW, S. C.—L. F. Westerbund, of Chester, S. C., is installing a new electric lighting system at Cheraw with a capacity of 25 arc and 800 incandescent lights.

RICHMOND, VA.—The City Council has granted a franchise to the Merchants' Light & Power Company.

NEWPORT NEWS, VA.—It is stated that the Council will appoint a committee to report on the advisability of establishing a city electric light plant.

SEATTLE, WASH.—The Board of Public Works on Oct. 6 rejected all bids recently received for the generators for the municipal electric light plant. The lowest bid received was submitted by Kilbourne-Clark Company, of Seattle, for $16,933. New bids will be called for at once.

WAUTOMA, WIS.—The citizens have voted to issue bonds for the construction of an electric light plant.

RICHLAND CENTER, WIS.—The citizens on Oct. 6 voted to issue $20,000 bonds to purchase the electric light plant of G. H. Strong.

RANDOLPH, WIS.—The contract to install the municipal electric light plant has been awarded to Langstadt & Meyer, of Appleton.

TORONTO, ONT.—Negotiations are under way by which the Stark Electrical Company, of Toronto, Ont., hopes to take over the plant of the Humber Power & Light Company. The Stark people have a new system with which they expect to revolutionize the telephone service, and they are anxious to get it into operation at Toronto Junction while some day they intend to invade Toronto. The Humber Power & Light Company is capitalized at $100,000.

MONTREAL, QUE.—Mr. Charles F. Phelps, the Baltimore electrical engineer engaged as an expert by the special committee of the City Council of Montreal, named to enquire into the proposal of placing all wires in the city underground, states that he has completed estimates for a conduit system for the city. The plans permit of readjustments without materially altering the project as a whole, and will enable Montreal to put all its wires underground without any exceptional difficulty or cost.

MONTREAL, QUE.—The Montreal Light, Heat & Power Company is negotiating with the Shawinigan Power Company, of Shawinigan Falls, Que., for an additional supply of electric power to be delivered at as early a date as possible. The first contract for power supply, which was for 8,000 horse-power, has been successfully carried out and has proved so satisfactory, notwithstanding that this power supply comes from a distance of over 80 miles from Montreal, that the Montreal company now wants to get an additional 10,000 supply of horse-power immediately. It is said that the Montreal company can make a larger profit on the Shawinigan supply than it can from the power generated by the company itself at Chambly and Lachine close at hand.

THE ELECTRIC RAILWAY.

ANNISTON, ALA.—It is understood here that plans are forming for the construction of an electric railway from Pyriton to Lineville, a distance of 7 miles.

ENSLEY, ALA.—A franchise has been granted to the Birmingham & Steel Cities Railway Company to operate a street railway throughout the city.

TUCSON, ARIZ.—The Tucson Street Railway Company has asked for a 25-year franchise covering all the business streets of the city. The company also wants a franchise for an electric lighting system. As consideration, the city is offered 100 arc street lights at $5 a month. The application is opposed by the Tucson Electric Light Company, which is getting $10 a month from the city for each of the fifty-one street lights.

TUSCAN, CAL.—Bids are wanted for the construction and equipment of an electric railway from Red Bluff to Tuscan, a distance of about 9 miles. Address, Tuscan Mineral Springs Corps.

SAN FRANCISCO, CAL.—The question of issuing bonds by the city for the purchase and operation of the Geary Street cable railway was voted upon by the citizens on October 8. The result was adverse to the proposition, which was beaten by over 6000 votes.

LOS ANGELES, CAL.—The Fresno Traction Company has been incorporated in Fresno County with a capital stock of $5,000,000, the incorporators being W. G. Kerckhoff, A. C. Balch, H. P. Baumgartner and W. E. Durfee, of Los Angeles, and A. G. Wilson, of Fresno.

NORWICH, CONN.—At a meeting of the directors of the Groton-Stonington Street Railway Company, a committee was selected to engage an engineer to begin the construction of the road, and another committee was appointed to secure the necessary rights of way. The company has secured property at Mystic as a site for the new power house.

KANKAKEE, ILL.—The Kankakee Interurban Riverview Railway Company has been incorporated; capital stock, $2500. Incorporators: Haswell Wesley, James Bonfield, Gordon Hannah and John C. Dixon.

CHARLESTON, ILL.—The Charleston, Champaign & Northern Interurban Railroad Company, with a capital stock of $10,000, has been incorporated for the purpose of constructing an interurban line from Charleston to Homer.

MOLINE, ILL.—The Mississippi Valley Traction Company has been incorporated, with a capital stock of $600,000. Incorporators and directors: William P. Kopf, E. Scott, H. W. Nichols, Jr., Frederick W. Hill and Albert J. Claussen, Chicago.

AURORA, ILL.—An attempt was made by two men to hold up a car on the Riverview Park line just outside of the city limits on the night of October 8. The result was that one of the robbers was killed and the other probably fatally wounded.

CHICAGO, ILL.—The Blue Island, Riverdale and Hammond Street Railway, with offices at Chicago, Ill., and Oklahoma City, Okla., has been chartered at Guthrie, Okla., to operate a street railway in the suburbs of Chicago to Joliet, Finley Park and Lansing, Ill. The capital stock is $1,500,000.

CANTON, ILL.—The Illinois Central Electric Railway Company has been incorporated; capital, $300,000. The incorporators and first board of directors are Joseph David, Cleveland, Ohio; James A. Lawrence and James S. Hopkins, Chicago, Ill.; Fred A. Dolph, Aurora, Ill.; David J. Peffers, Jr., Evanston, Ill.

CHICAGO, ILL.—The council of Evanston has been asked to grant a fifty-year franchise to the Chicago & Milwaukee Railway Company, the purpose being to build a street car line through the west part of the suburb, in which the service has long been recognized as inadequate. The plan is to parallel the tracks of the Chicago Consolidated Traction Company.

CHICAGO, ILL.—The corporation counsel has rendered an opinion to the effect that the city ought to get compensation for advertising from the Northwestern Elevated Company, but that he cannot recommend a suit to recover such compensation because the city has no right to allow the elevated roads to advertise on platforms over streets and alleys. Five ordinances are now before the city council to give the various elevated roads this privilege.

PAOLI, IND.—Dispatches state that the Louisville and South Indiana Traction Company has filed a mortgage of $1,000,000 to cover the construction of an electric road from Louisville and New Albany to French Lick Springs.

INDIANAPOLIS, IND.—The Hoosier Power & Traction Company, of Vincennes, has been incorporated with a capital stock of $50,000. Directors: O. N. Greist, H. H. Crooke, W. L. Stoy and others.

NEW ALBANY, IND.—The Louisville & Southern Indiana Traction Company has asked the County Commissioners for a right of way through the county for an electric railway from New Albany to Paoli and French Lick and West Baden Springs.

MICHIGAN CITY, IND.—Judge Baker, of the Federal Court, has ordered the Lake Cities Electric Railway property to be sold under a decree of foreclosure in favor of the Metropolitan Trust Company, of New York. The decree directs that the road be sold at public auction at Laporte, and that no bid under $40,000 be accepted. Alexander A. Boyd, of Terre Haute, is receiver.

CEDAR RAPIDS, IA.—Col. W. G. Dows and Isaac B. Smith, of Cedar Rapids, who are now engaged in constructing the Cedar Rapids, Iowa City & Southern Interurban Railway, are considering plans for the construction of another interurban line. This new line will be built in a northwesterly direction from Cedar Rapids, through Linn, the objective point being Waterloo. The line will be about 54 miles in length. It is stated that financial arrangements have already been made, and that the work of constructing the line will commence in the spring

KANSAS CITY, KAN.—There is a project forming of building an electric railway from Kansas City to Jefferson City and thence to the lead and zinc fields of Missouri. This information has been given out by P. H. Coney, an attorney, of Topeka, Kan.

NAHANT, MASS.—The voters have at a special election decided in favor of an electric railway. The Selectmen will meet and consider the propositions of the two rival companies.

WORCESTER, MASS.—The project for a street railway between Worcester and Providence, R. I., which has been dormant for a year, has been revived. At a meeting in Milbury the subscribers to the $200,000 of stock it is proposed to issue chose these directors: Fred C. Hinds, of Newton; Charles H. Wilson, of Brookline; Henry F. Rice and Henry S. Stockwell, of Sutton; Dr. Silas D. Holbrook, of East Douglass; Henry B. Bullard, of West Sutton, and William E. Horne, of Millbury. There are assurances from the preliminary work that has been done that there will be no difficulty in getting the franchises.

TRAVERSE CITY, MICH.—L. N. Gibbs et al. have been granted a franchise for a street railway. They will at once organize the Traverse City & Peninsular Railway Company.

BENTON HARBOR, MICH.—Right of way is being secured for an electric railway from Benton Harbor to South Haven. Mr. Mueller, a Chicago lumberman, owns a large part of the property necessary for the right of way, and it is reported that he offers to donate land for the power house, besides a liberal cash donation when the road is completed.

BAY CITY, MICH.—The Bay Cities Consolidated Street Railway Company, which has been in the hands of a receiver for about three years, has been sold to H. D. Walbridge, of Detroit, representing the Bay City United Traction Company, a corporation recently organized to take over the property. There was but one bid, the price offered being $500,000.

NEW YORK, N. Y.—An extension of the rapid transit system to Van Cortlandt Park is regarded as almost certain in view of the outcome of two auction sales of property in that neighborhood. The sales involved two tracts, one of about twelve acres and the other of less than one acre.

NEWARK, OHIO.—The Newark, Martinsburg & Mount Vernon Traction Company intends to build an extension to Wooster.

GREENVILLE, OHIO.—The People's Rapid Transit Company has secured a franchise in this place. The company will build a line from Toledo to Greenville.

GUELPH, ONT.—The by-law for taking over the Guelph Radial Railway Company by the city of Guelph has been voted on and passed. The cost will be $78,000.

BANGOR, PA.—The Bangor, East Bangor & Portland Street Railway Company has purchased the large plant of the Bangor Electric Light, Heat & Power Company. The trolley company intends making some alterations, after which it will extend the line from the present terminus at Portland to the Delaware Water Gap and Stroudsburg.

CONNELSVILLE, PA.—A charter has been granted the Monongahela & Clairton Street Railway Company. The incorporators are Paul W. McCully, W. P. Whitledge, John G. Parke, Jr., Cullin Armstrong, William H. Lewis, B. W. Castner, John W. Ailes, William H. Binns, J. N. Mullin and Oliver S. Scott. The capital stock of the company is $75,000.

PROVIDENCE, R. I.—The Providence & Burrillville Street Railway Company, which is planning to build a double-track electric railway between Woonsocket and Providence, connecting with the Rhode Island Company's system to the south and the Woonsocket Street Railway Company to the north, has organized. The following-named officers have been elected: President, E. H. Rathbun; general manager and treasurer, E. K. Ray; secretary, Frank E. Holden.

MEMPHIS, TENN.—It is reported that the Memphis Street Railway Company will build an 18-mile line to Collierville.

TRENTON, TENN.—The Gibson County Construction Company has been organized for the purpose of constructing an electric railway from Trenton to Eaten, Brazil and Gibson Wells. The projected route is about 17 miles long. A survey is to be made at once.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has a large corps of men at work investigating and securing estimates on the amount of improvements to be made on the different lines of the company. It is said that during the next six months the road is to be entirely rebuilt in many places.

FORT WORTH, TEX.—The construction of an interurban electric railway from this city to Mineral Wells, Tex., is projected. The distance is about 57 miles. The route of the proposed road is through the towns of Azle, Reno, Springtown, Poolville, Whitt and Salersville. John W. McCracken, of Springtown, can give information in regard to the enterprise.

CORPUS CHRISTI, TEX.—C. B. Moling, of Moling Bros., who have had plans prepared for the establishment of a great pleasure resort here, says that more than $1,000,000 will be expended in the construction of the interurban electric street railway line that is to run from this place to Portland, Tex., and in other improvements which are to consist of a 600-room hotel, fifty cottages, opera house, casino, etc.

HOUSTON, TEX.—Ed Kennedy, the promoter of the proposed interurban electric railway that is to be built between Houston and Sour Lake has returned from Pittsburg, Pa., Cleveland and Columbus, Ohio, where he says he was successful in perfecting plans for financing the project. The right-of-way and survey for the road has been secured and the work of construction is to soon commence according to present plans. The central power station will be located at Liberty.

NORFOLK, VA.—Deeds have been filed here by the Newport News & Hampton Street Railway separating the interests of the Williams syndicate and of Alex. Brown & Sons, of Baltimore. The deeds are from the Richmond Trust & Safe Deposit Company and release the property and securities pledged under a deed of trust to secure an issue of $2,000,000 of income bonds issued in June, 1902.

NEW INDUSTRIAL COMPANIES.

THE BAKER MOTOR VEHICLE AGENCY, of New York, has been incorporated; capital, $25,000. Directors: J. E. Delmar, Louis Hall and A. B. Rulison, New York.

THE LANDERS ELECTRICAL COMPANY, of San Francisco, has been incorporated with a capital stock of $500,000. The subscribers to the stock are C. K. Harley and C. W. Landers.

THE AUTOMATIC ELECTRIC SIGNAL COMPANY has been incorporated at Newark, N. J.; capital, $200,000. Incorporators: Antonio Scarturro, Joseph Gifuni and Walter C. Law.

THE EDISON AUTOMOBILE COMPANY, of Washington, D. C., has been incorporated at Camden, N. J., capital $100,000. Incorporators: Edward H. Chew, Wilfred B. Walcott and Norman Grey.

THE TOQUET MOTOR CAR AND CONSTRUCTION COMPANY has been incorporated at New York; Capital, $25,000. Directors: B. L. Toquet, Westport, Conn.; Oscar Wuerz, Conrad Stein, New York.

THE IMPROVED ELECTRIC LIGHT & HEAT COMPANY, of New York, has been incorporated; capital, $10,000. Directors: John Knobloch and G. K. Hartung, New York; G. W. Wallace, Mount Vernon.

THE ELECTRIC COTTON LEATHER BELTING COMPANY, of New York, has been incorporated; capital, $5000. Directors: W. J. Berg and J. S. Lawson, Brooklyn, and W. W. Benjamin, Arlington, N. J.

THE NEW YORK GARAGE COMPANY, of East Orange, N. J., has been incorporated with a capital stock of $50,000 to manufacture motor vehicles. The incorporators are James B. Richardson, Walter H. Bond and Gardner W. Kimball.

THE TOLEDO STORAGE BATTERY AND ELECTRICAL COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $100,000. The incorporators are G. L. Miller, C. R. Clapp, L. A. Alexander, M. H. Griffin and F. H. Alexander, of Toledo.

THE ROYSE-BATLEY ELECTRIC COMPANY, of Indianapolis, Ind., has been incorporated and has succeeded the business of Royse & Batley. The company's headquarters are at 16 E. Market Street, where it carries on a business as electrical contractors.

THE WACO ELECTRICAL SUPPLY & PLUMBING COMPANY has amended its charter, changing its name to the Duncan-Hobson Electric Company and removing its headquarters from Waco to Dallas. It has also increased its capital stock from $40,000 to $80,000.

THE WHEELER ELECTRIC COMPANY has been incorporated in New York to manufacture electrical machinery. The capital stock is $5,000 and the incorporators are Samuel W. Wheeler, New York City, Walter S. Sinclair, Sea Gate, and Geo. L. Lockwood, New York City.

THE AMERICAN ELECTRIC BRAKE COMPANY has been incorporated at Newark, N. J., the authorized capital stock being $100,000. The company will manufacture brakes for street vehicles. The incorporators are Thomas L. Nixon and Lester W. Cockefair, of New York, and Adrian I. Tichenor, of Newark.

THE HOLCOMB MANUFACTURING COMPANY has been incorporated at Hartford, Conn. The company, which is a New Haven concern, takes over the business of H. C. Holcomb, automobile manufacturer. The authorized capital is $50,000 and the incorporators are H. C. Holcomb, Henry W. B. Manson and Mr. Tolman.

LEGAL.

WESTERN UNION IN NEW ORLEANS.—The Western Union Telegraph Company has entered suit against the City of New Orleans and Foster Olroyd, city electrician, to enjoin the defendants from in any manner interfering with its wires in the city. The Western Union Telegraph Company controls and operates the National District Telegraph Company in that city. It wished to install a service in the United States Mint, and asked Mr. Olroyd for permission to do so. This was refused and Mr. Olroyd ordered the wires taken down. Mr. Olroyd claims that the National District Telegraph Company has no permission to operate in New Orleans.

TELEPHONE COMPANIES COMMON CARRIERS.—Judge Artman, of the Boone Circuit Court, in Indiana, has ruled that when a telephone company opened its switchboard and granted connection with another telephone company, it became a common carrier of oral messages, and as such cannot discriminate between companies in the county seeking connection with it; that it is bound under the law to admit all companies seeking such service on equal terms. The case involved was that of the Thorntown Co-operative Telephone Company which brought suit against the Lebanon Telephone Company to compel the latter to give the Thorntown Company switchboard connection. The Lebanon Company had already given such privileges to another Thorntown company. The ruling is interesting rural telephone companies who hope to obtain desirable connections if it is sustained by the higher court to which the case will be appealed.

NEW YORK CONDUITS.—New York City, by direction of Mayor Low, is going to sue the Consolidated Telegraph & Electrical Subway Company for an accounting of an indeterminate amount under the clause of the company's contract with the city which says that the annual profits in excess of 10 per cent. on the actual cash capital invested shall go to the city. Edward Owen, Commissioner of Accounts, has made a report to the Mayor to the effect that the profits have been more than 10 per cent. on the actual cash capital invested, and that the city has been deprived of a large revenue partly by a system adopted by the company of charging against earnings high rates of interest upon obligations to subsidiary companies, which would have been unnecessary if the company had begun with the necessary capital. The contract was entered into in 1886. The report gives the list of the company's shareholders. The largest holders of stock are the State Trust Company, 15,160 shares; Horace M. Kilborn, 2000 shares; Charles R. H. Gilbert, 550 shares; New York Edison Company, 138 shares, and Edward Lauterbach, 100 shares.

OBITUARY.

MR. JOHN GRAHAM MILLAR, manager of the roofing department of the H. W. Johns-Manville Company, New York, died at St. Luke's Hospital on October 15, 1903, in his forty-second year.

MR. R. P. SCALES, formerly general manager of the Consolidated Car Heating Company, died last week. He was identified with the company for a number of years, having been the Chicago representative for five years, and general manager at Albany for two years. He retired from active participation in the selling branch of the company about a year ago. His death occurred in Boston.

PERSONAL.

S. W. CHILDS.

MR. S. W. CHILDS, recently general manager of the Kalgoorlie Electric Tramways, of Kalgoorlie, Western Australia, has just returned to this country after an absence of several years. Mr. Childs started in the electric railway business on the old Watervliet Turnpike R. R. at Albany, N. Y. He went to Boston in 1890 and remained in the employ of the old West End Street Railway Company for two years. He then went to Lincoln, Neb., where he was engaged in construction work. He went to Brooklyn in 1892 and was employed with the Atlantic Avenue R. R. under the late Deacon Richardson, well-known to many old electric railway men of this country. Mr. Childs left Brooklyn to enter the employ of J. G. White & Company, and was assigned to Baltimore, Md., where he had charge of track and overhead construction work. He next went to Columbus, Ohio, and was superintendent of construction for the Columbus Central Railway Company, for which he laid out the entire track, overhead and pleasure park system. He left Columbus in 1896 to take charge of construction work at Fort Wayne, Ind., for the Degnon Construction Company. He went to Charleston, S. C., in 1898 and had charge of construction work on the electric railways in that city. In the fall of 1898 he went to Australia for the first time and became assistant engineer for J. G. White & Company in connection with the electric tramways at Perth, Western Australia. He returned to America in 1901 and had charge of construction for the Toledo & Munroe Electric Railway. He left this position to return to Australia as manager of the Kalgoorlie Electric Tramways. Mr. Childs, on his recent trip to America, made an extensive tour of New Zealand, the Philippine Islands and a few cities in China and Japan, where electric tramways are contemplated or are being built. At each of these places Mr. Childs has increased his long list of friends and at the same time added substantially to his enviable record for carrying out work on a broad scale with unusual efficiency and energy and with uniformly good results.

MR. E. F. PECK, general manager of the Schenectady Railway Company, has been elected president of the gas part of the enterprise also.

MR. P. G. GOSSLER, chief engineer of the Montreal electric light and power system was a welcome visitor in New York City during the past week.

MR. M. J. HIGLEY, superintendent of the Belvidere, Ill., Gas & Electric Co., has resigned and has become manager of the Iowa City, Ia., Gas Light Company.

MAJOR BLAND, of the Royal Engineers, has, it is stated, lately been visiting Newfoundland to study the question of the protection of British cables across the Atlantic, in war time.

SIR W. H. PREECE, F.R.S., has recovered from his recent severe attack of pneumonia, and accompanied by two daughters is now making a tour of convalescence in Egypt and the Holy Land.

MR. PETER COOPER HEWITT has been abroad with his wife making a long automobile trip in Europe. Mr. Hewitt is greatly set up by the change and is expected to arrive in New York this week.

MR. E. S. LEA, of the De Laval Steam Turbine Company, has returned from a western trip. He says that business in the electrical line is much more flourishing in the west than it is in this section of the country.

MR. E. E. WEBSTER, formerly general manager of the Twin City Telephone Company, of Minneapolis, Minn., has been appointed general manager of the Independent Telephone Company, of Seattle, Wash., and has proceeded to assume his new duties.

MR. E. THURNAUER, head of the French Thomson-Houston Company, has returned to Paris this week after a long stay on this side, during which he has visited various parts of the country and looked up electrical progress on this side of the Atlantic.

MR. D. AMOSO MAZENET, of Mexico City, who is general manager of the Mexican General Electric Company, is now on a visit to the States. He will be here, according to present arrangements, for at least a month at General Electric headquarters.

MR. RICHARD H. RICE, formerly of the Rice & Sargent Engineering works, which are now part of the Providence, R. I., Engineering works, has been appointed to the management of the manufacturing end of the Curtis turbine business at Schenectady.

DR. CLAYTON H. SHARP, testing officer of the Lamp Testing Bureau of the Association of Edison Illuminating Companies, has sailed on the *Blucher* for England. He goes to London, Glasgow, Berlin, Munich and other places to study up the latest laboratory methods and ideas.

MR. S. W. ASHE, of the staff of the Brooklyn Polytechnic Institute, is delivering a course of engineering lectures at the Railroad Men's Building, in Brooklyn. It is understood there will be 48 lectures in the course, and the indications are that they will meet a marked educational want.

MR. HENRY RUSTIN, chief of the mechanical and electrical department of the St. Louis Exposition, is now visiting in New York State. He went recently to Colorado for his health and returned to St. Louis to clean up some work. Further rest and change are necessary, however, after the ordeal of the last two years.

MR. E. RATHENAU, who is so prominently connected with electrical interests in Germany, sailed on Tuesday by the North German Lloyd steamer, *Kaiser Wilhelm Second*, for home. He has spent a good deal of time with the General Electric representatives and is understood to have made a very thorough investigation of the Curtis steam turbine with his engineering staff.

MR. E. W. ROBERTS, who is well-known to the gas-engine trade as author of the gas-engine handbook and numerous other works on gas engines and automobiles, and as a designer and consulting engineer, is fitting up a laboratory at Clyde, Ohio, for the testing of gas and gasoline engines and gasoline automobiles as well as for calorimetry and analysis of both gas and liquid fuels.

NEW YORK ELECTRICAL SOCIETY.—The following-named gentlemen were elected members of the New York Electrical Society at the meeting of October 19: William Thomas Taylor, Schenectady, N. Y.; George W. Travis, Brooklyn, N. Y.; Sydney Hogerton, New York; Adolph G. Koenig, New York; Edgar H. Berry, New Brighton, N. Y.; Howard S. Rich, New York; Dr. John Woodman, New York.

ABADIE-BOLLING.—The wedding took place at Louisville, Ky., on October 5, of Mr. Eugene H. Abadie, to Miss Alice G. Bolling, member of a well-known old Southern family of that city. Mr. and Mrs. Abadie will make their residence in this city. Mr. Abadie has long been prominent in electrical matters through his connection with the Wagner Company, of St. Louis, and is now in the management of the Elblight Company of America.

MR. W. J. HAMMER, the consulting electrical engineer, whose recent lectures on radium have attracted so much attention, has now been placed under contract by the Pond Lyceum Bureau to deliver his lecture this winter before a number of well-known social and scientific bodies of high standing. Last winter Mr. Hammer lectured nine times and there is a great call for his services. The radium lecture is quite fascinating and very instructive.

MR. VAN RENSELLAER LANSINGH, the illuminating and electrical engineer, of Chicago, has been engaged to work out a preliminary scheme of general illumination for the Lewis & Clark centennial exposition, to be held at Portland, Ore., in 1905. The illumination of the buildings and the grounds will be made a special feature of the exposition. Four-candle power lamps will be adopted as the unit of illumination in place of the eight-candle-power lamps used at the Pan American Exposition and at the Louisiana Purchase Exposition.

DR. LEE DE FOREST sailed October 14 on the White Star steamer *Majestic*, for England, taking with him his chief assistant, H. M. Horton, and two outfits of De Forest wireless telegraph, at the request of prominent men connected with the British Post Office, the Admiralty and others. A demonstration is to be made between Holyhead and Dublin and all facilities of the Post Office have been put at Dr. De Forest's disposal towards this end. It is said that Sir William Preece is especially interested in the test. The matter of speed of transmission will be especially observed. It is the intention of those interested in Great Britain to incorporate the British Empire De Forest Company upon the completion of the tests.

Trade Notes.

OIL FILTERS FOR BUENOS AIRES.—The Burt Mfg. Co., Akron, Ohio, recently filled an order for four Cross oil filters from Buenos Aires, Argentine Republic.

MR. WM. T. PRINGLE, Philadelphia, the well-known switchboard constructor and manufacturer, has recently removed to 1906 North 6th Street, the change being necessary to secure increased facilities.

MALTBY LUMBER CO., Bay City, Mich., has issued a very neat little pamphlet in regard to its poles for telephone, traction and electric light purposes; and its ties for trolley lines and steam roads. It will go in an ordinary envelope, but contains a lot of information and is well illustrated of more than usual utility and some of it of permanent value.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agent for McBride "Arkless" cartridge fuses, writes that these fuses are now made for voltages up to 500 volts. They are furnished in any capacity up to and including 30 amperes. They fit any and every style fuse connection in all style of fuse blocks, are easy to use, perfect in action, and are reliable.

DOUBLEDAY-HILL COMPANY.—This company will shortly issue its new catalogue, which will be one of the largest and most complete ever issued by an electrical supply house. The fact that it will contain considerably over 1000 pages gives some idea of its size and scope. Furthermore, there will be some very important and valuable features never embodied in a publication of this kind before.

THOS. G. GRIER COMPANY, 128 W. Jackson Boulevard, Chicago, Ill., has been appointed western representative for the sale of the Kinsman specialties. This company will carry a stock of the goods in Chicago so that immediate deliveries can be made. The goods will be sold at the same prices and terms as if they were bought direct from the manufacturer. All inquiries will receive the prompt and careful attention of Thos. G. Grier Company.

FIREMEN'S TOURNAMENT.—At the recent State Firemen's Tournament of Pennsylvania, held at Allentown, there were some fine lighting effects. The illuminations and lighting decorations were done by Mr. F. C. Gardner, of Summit, N. J., who used the Norbitt temporary socket. Mr. G. F. Rohn, of Milwaukee, writes the Pass & Seymour Company that within two months he had used upwards of 2000 of its new sockets on various kinds of work.

PACIFIC COAST POWER PLANTS.—Under the title of "Steam Power Plants of the Pacific Coast," Chas. C. Moore & Company, engineers, of San Francisco, have issued a very handsome pamphlet illustrating and describing a number of the fine plants which they have constructed and engineered during the past few years on the Pacific Coast and in the Hawaiian Islands. Many of the plants are for electric lighting, street railway or power transmission work.

SCHMIDT TELEPHONE APPARATUS.—The Lambert Schmidt Telephone Mfg. Company, Weehawken, N. J., has just installed in the new Butterick Building, New York, a 120-drop telephone switchboard, common-battery system. The New Amsterdam Theatre and the New York Theatre have recently been equipped with the Schmidt automatic intercommunicating telephone system. Other contracts just closed are equipments for the Adjutant General's office and Bureau of Ordnance in Washington, D. C.

PRAIRIE FIRE DRAG.—A folder describing the "Prairie Fire Drag," a device for extinguishing prairie fires, is being sent out by the H. W. Johns-Manville Co., 100 William St., New York. The drag consists of a chain mat covered with an asbestos smothering blanket supplied with chains at two corners, and may be easily and quickly adjusted to drag by the horn of a saddle or by single tree. A wash drawing by the well-known illustrator, Mabie, shows two mounted cowboys putting out a prairie fire with the drag.

"COMPRESSED FIBRE" is the name of a useful product intended to be used in place of hard rubber. It has been on the market for some time in the shape of photographic apparatus, but is now made for telephone receiver shells, telephone mouth pieces, battery jar covers, switch bases, etc. Certain particularly good features are present in Compressed Fibre which render it quite different in working from other hard rubber substitutes. The manufacturer is known as the Compressed Fibre Company and is located at 6 Beacon St., Boston, Mass. The president is George W. Nock, vice-president, George H. Hill and secretary, John C. Sherman.

THE THOS. E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY, of Detroit & Pontiac, Mich., announces that its business for this fall and winter looks exceedingly encouraging. It is getting out instruments for two stations for the government work at Washington and Baltimore, and numerous orders for colleges, universities, high schools and individual sets for short distances keeps it busy to the full capacity. The company is moving into its new factory at Pontiac. It is preparing instruments to be used at the Universal Exposition at St. Louis, where it will have three stations in constant operation. This company is now looking for students to take up wireless telegraph operation.

NEW MAGNETO TESTING APPARATUS.—The Eureka Electric Company at its new factory at Genoa, Ill., has just perfected improved apparatus for the purpose of testing each and every magneto telephone generator manufactured by this company, and in addition to the testing of its generators it has devised a very ingenious instrument for the purpose of testing and computing lines of force obtained in a generator magnet. By this method it is enabled to manufacture each and every generator exactly alike and secure absolute and improved results from every one of their machines. First, after assembling the generator, it is tested for milliamperes output and then its voltage, and any machine falling below a given standard, which standard is a very high one, it is rejected. Before the magnets reach the assembling room, each and every one of them after being magnetized is tested for lines of force or, in other words, its strength in magnetism. The Eureka Electric Company is now distributing its new No. 26 and 27 Bulletins, describing its high-grade line of apparatus, beautifully illustrating the same, in addition to its splendid Catalogue No. 23.

NAME PLATES.—Until recently, the manufacturer of dynamos, motors and other electrical machinery was content with labeling his product with any and every kind of name plate. In fact, this was considered such an unimportant detail that very little, if any, attention was given to it. As the manufacture of electrical machinery became more systematized, a great deal of attention was given to details and the general appearance of the finished product, whereupon the name plate also came to receive its share of attention. It was recognized that this ought to be of such a shape, character and finish that it would not detract from any favorable impression the machine itself might create. Recognizing the need for offering the best at the lowest possible price consistent with good workmanship, the Crowe Metal Mfg. Company, of Chicago, formerly the Bogue & Crowe Manufacturing Company, has made a specialty of this line, and has perfected what is known as the Crowe process, whereby a high-grade raised-letter name plate can be produced automatically from sheet metal of different qualities and thicknesses. It is also prepared to do embossed work on metal, or, in fact, any work of a similar nature. It has recently increased its facilities so as to be able to fill all orders promptly for its growing business. Among its customers it numbers some of the best-known manufacturing companies in the country.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 13, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

741,044. STORAGE BATTERY; Charles W. Kennedy, Rutledge, Pa. App. filed March 21, 1902. (See page 685.)

741,052. AUTOMATIC COUPLING FOR ELECTRICAL CONDUCTORS; Charles Mahon, Washington, D. C. App. filed Jan. 4, 1902. Two bars each having a seat containing a contact and a spring opposite the seat, so that when one member is forced into the other, one side of the circuit will be closed by the spring engaging a part of the opposite member and the other side by the contacts in the two seats coming together. When the joint is separated, the spring bears against the contact in the seat and bridges the ends of the circuit.

741,097. STREET RAILWAY SWITCH; Walter J. Bell, Los Angeles, Cal. App. filed Aug. 5, 1902. The switch tongue is moved by a pneumatic piston, the air being controlled by an electro-magnetic valve.

741,114. APPARATUS FOR TELEPHONE TRUNK-LINES; William W. Dean, Chicago, Ill. App. filed Jan. 14, 1902.

741,115. RELAY; William W. Dean, Chicago, Ill. App. filed Jan. 14, 1902.

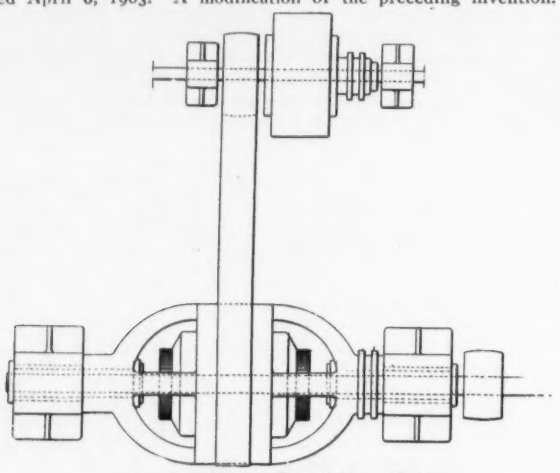
741,118. MEANS FOR OPERATING RAILWAY SWITCHES; Joseph O. Dimmick, Denver, Colo. App. filed Jan. 21, 1903. An oscillating shaft is made the core of an electro-magnet, the poles of which are projected towards the switch point and then rotated, causing the point to follow the poles by the magnetic attraction therebetween.

741,123. ELECTRIC TRACK INSTRUMENT; Taylor T. Fogel, Allentown, Pa. App. filed Aug. 8, 1902. An oscillating magnet is placed near the rail so that the car wheel in moving past it will exercise a magnetic influence to oscillate the magnet in the direction in which the train is moving and thus close a signal circuit which indicates the direction of movement of the train.

741,168. ELECTRIC SWITCH; Joseph H. Rusby, Nutley, N. J. App. filed March 20, 1902. Details.

741,206. ELECTRIC RHEOSTAT; Leonard Wilson, Pittsfield, Mass. App. filed April 6, 1903. The invention consists in cutting out parts of the resistance in series with a circuit and simultaneously cutting in a shunt resistance, thereby effecting a saving in resistance material while an even adjustment of circuit strength.

741,207. ELECTRIC RHEOSTAT; Leonard Wilson, Pittsfield, Mass. App. filed April 6, 1903. A modification of the preceding invention.



741,471.—Power Translating System.

741,231. PROCESS OF TREATING CYANIDE SOLUTIONS; William H. Davis, Boulder, Col. App. filed July 3, 1902. (See page 685.)

741,234. CONTINUOUS CURRENT MACHINE AND APPARATUS; Max Deri, Vienna, Austria-Hungary. App. filed March 6, 1903. A field magnet in the form of a continuous ring slotted on its inner periphery and carrying exciting coils and equally distributed compensating coils in the slots for the purpose of neutralizing any tendency to armature reaction.

741,239. CIRCUIT BREAKER; Joseph D. Forrer, Johnstown, Pa. App. filed March 12, 1902. The arcing is subdivided by breaking the circuit at a plurality of points in series.

741,245. ELECTRIC LAMP OR CANDLE; Conrad Hubert, New York, N. Y. App. filed Feb. 27, 1903. A structure resembling a candlestick and candle, an electric lamp being located where the flame usually occurs and the candle body containing a battery cell the current from which is controlled by a switch on the handle.

741,255. ELECTRIC ARC LAMP; George M. Lane, Brooklyn, N. Y. App. filed Nov. 18, 1902. Details of an improvement in gas checks.

741,268. QUICK ACTION MAKE AND BREAK SWITCH; William C. O'Brien, Baltimore, Md. App. filed May 14, 1902. Details of a switch having a quick movement on both the make and break.

741,271. TURBINE ELECTRIC GENERATOR; Edwin H. Porter and Burleigh Currier, Philadelphia, Pa. App. filed Oct. 9, 1902. (See Current News and Notes.)

741,272. ELECTRIC INDUCTION-MOTOR; Edwin H. Porter and Burleigh Currier, Philadelphia, Pa. App. filed Feb. 7, 1903. (See Current News and Notes.)

741,274. APPARATUS FOR ELECTROPLATING; Albert R. Pritchard, Rochester, N. Y. App. filed June 23, 1903. (See page 685.)

741,282. TELEPHONE SYSTEM; Charles B. Smith, New York, N. Y. App. filed Feb. 3, 1899.

741,283. TELEPHONE; Charles B. Smith, New York, N. Y. App. filed March 6, 1899.

741,284. TELEPHONE SYSTEM; Charles B. Smith, New York, N. Y. App. filed Dec. 18, 1899.

741,285. TELEPHONE SYSTEM; Charles B. Smith, New York, N. Y. App. filed Dec. 30, 1899.

741,290. MEANS FOR PREVENTING FLUCTUATIONS IN ROTARY MOTORS; James J. Wood, Fort Wayne, Ind. App. filed July 16, 1900. The fly-wheel is connected with its shaft through two reversely arranged spiral springs adapted to be wound and unwound by relative movements of the wheel and shaft, to prevent "hunting" and fluctuations generally.

741,312. RAILWAY SIGNALING SYSTEM; Adolph G. Dahmke, Chicago, Ill. App. filed Feb. 3, 1903. Details.

741,322. ELECTROLYTIC WATER-PURIFIER; George W. Frazier, Allegheny, Pa. App. filed Jan. 3, 1903. (See page 685.)

741,333. ELECTRIC FURNACE; Francis E. J. Hatch, Greenbay, Wis. App. filed Dec. 4, 1902. (See page 685.)

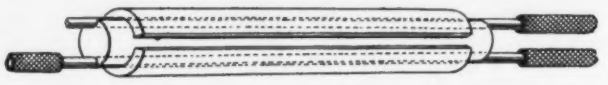
741,358. ELECTRIC CLOCK; Frank W. Moore, Maywood, Ill. App. filed May 24, 1897. The gong hammer is actuated at each stroke by an electro-magnet, the hammer on the rebound moving the train.

741,371. APPARATUS FOR THE TREATMENT OF DEFECTIVE HEARING; Guy C. Powell and Allen D. Smith, Peoria, Ill. App. filed May 28, 1902. The tympanum of the ear is massaged by directing impulses of air against it; a bellows being actuated rapidly by an electro-magnet through which an interrupted current flows.

741,392. SHOE FOR THIRD RAILS; James E. Blakesley, Chicago, Ill. App. filed April 27, 1903. The shoe is pivoted to the end of a bell-crank and makes under contact with the rail.

741,393. SUPPORT OR CHAIR FOR THIRD RAILS; James E. Blakesley, Chicago, Ill. App. filed April 27, 1903. The support consists of a bracket to which an under contact rail is secured as well as a housing to protect the rail from the weather.

741,395. STEERING MECHANISM; Frank T. Cable, New Suffolk, N. Y. App. filed Nov. 7, 1902. The steering may be accomplished by hand or by an electric motor under the control of the hand. The motor is arrested automatically when it has shifted the rudder to an extent governed by the hand operated devices.



741,480.—Wire Connector.

741,396. PRODUCTION OF NITROGEN COMPOUNDS; Guillaume de Chalmot, Leaksville, N. C. App. filed Jan. 23, 1903. (See page 685.)

741,413. COMPOSITE METAL ROLL; Charles J. Reed, Philadelphia, Pa. App. filed April 4, 1902. (See page 684.)

741,439. PROCESS OF TREATING ORES; Charles E. Baker and Arthur W. Burwell, Cleveland, Ohio. App. filed Dec. 23, 1902. (See page 684.)

741,471. POWER TRANSLATING SYSTEM; Arthur C. Eastwood, Cleveland, Ohio. App. filed April 3, 1903. A method of transmitting power from a driving to a driven member, consisting in interposing a dynamo whose elements are movably connected respectively to the two members; the speed of the driven member is altered by varying the electrical characteristics of the two elements of the dynamo.

741,480. WIRE CONNECTOR; Frederick P. Fuller, New York, and John J. Walsh, Yonkers, N. Y. App. filed Feb. 7, 1903. A conical spring sleeve inclosing a conical plug having a groove on each side for the main and branch wires.

741,490. ELECTRIC SWITCH; Arthur E. Handy, Providence, R. I. App. filed April 15, 1903. Details.

741,527. ELECTRICITY METER; William M. Mordey and Guy C. Fricker, Westminster, England. App. filed April 7, 1902. An energy absorbing device disconnected from the armature is arranged to act upon the latter only when the same nears the end of, but before it completes, its stroke in each direction and to then exert a damping effect on the armature during the remaining portion of its stroke; this is to obtain a nearly constant amplitude of movement of the armature.

741,563. WIRE SUSPENDING DEVICE; Herbert E. Stevens, Windber, and Burt Gallatly, Pittsburg, Pa. App. filed June 26, 1903. A two-part bolt having inclined surfaces which firmly fix the bolt in a socket when the parts are driven in.

741,570. DETECTION OF ELECTRICAL OSCILLATIONS; Louis Heathcote Walter, London, and James Alfred Ewing, Cambridge, Eng. App. filed April 29, 1903.

741,571. RAILWAY SWITCH AND OPERATING MEANS THEREFOR; Arthur J. Backer, Syracuse, N. Y. App. filed Feb. 9, 1903. The switch point contains a chamber in which is located an electro-magnet; the magnet is fixed with respect to the switch point and when energized attracts the latter and moves it.

741,573. ALARM SYSTEM; Ernest H. Ballou, Binghamton, N. Y. App. filed Aug. 13, 1901. A jail in which the bars are tubular and form a pneumatic system, the air from which is allowed to escape when a door is opened, and an electric signal is operated by the escape of the air.

741,592. ELECTROLYTIC DIAPHRAGM; Isaiah L. Roberts, New York, N. Y. App. filed March 7, 1903. (See page 685.)

741,599. TROLLEY; Artemas B. Upham, Boston, Mass. App. filed April 13, 1903. A double trolley designed for trackless roads, the wheels being placed horizontally and making side contact with the overhead wires, the invention including a bracket designed to permit two wheels to pass each other on the same wire.

741,604. COMBINED TELEPHONE TRANSMITTER AND RECEIVER; Charles Yeack, Akron, Ohio. App. filed March 13, 1903.

741,605. ELECTRIC TERMINAL; Henry R. Young, New Orleans, La. App. filed Nov. 19, 1902. The terminal comprises a hollow body open at its end and having apertured lugs at one end and also having a lateral socket provided with set screws to engage the end of the conductor and a clevis for a retaining cable.

12,162. POLE CHANGER; William F. Warner, Muncie, Ind. App. filed Nov. 5, 1901. Details of a device for sending reverse current to line for ringing bells and signaling generally.